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ABSTRACT

This book is one of a series in Course II of the Relevant Educational Applications of Computer Technology (REACT) Project. It is designed to point out to teachers two of the major applications of computers in the social sciences: simulation and data analysis. The first section contains a variety of simulation units organized under the following headings: The Computer Utility; Information Retrieval; Balance of Payments; Computer-Written Poetry; and Interpersonal Relationships. The second part consists of two basic statistical programs which perform the type of calculations and analysis frequently used in the social sciences. These are found under the headings Statistical Analysis and Best Line Fit for a Set of Points. Program runs and references to line numbers in the book apply to the Hewlett-Packard programs. A bibliography is also included. (FDI)

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TEACHERS

Course II

Computer-Oriented Curriculum

Tecnica EDUCATION CORPORATION

REACT

Book 5: Social Studies: Application Units

ED 075272

RELEVANT EDUCATIONAL APPLICATIONS OF COMPUTER TECHNOLOGY

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TECNICA EDUCATION CORPORATION

REACT

Relevant
Educational
Applications of
Computer
Technology

Course II TEACHERS
Computer-Oriented Curriculum

SOCIAL STUDIES: APPLICATION UNITS

by:
Northwest
Regional
Educational
Laboratory

REACT: Relevant Educational Applications of Computer Technology

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TABLE OF CONTENTS

Preface 5
Introduction 7

Social Studies Simulations

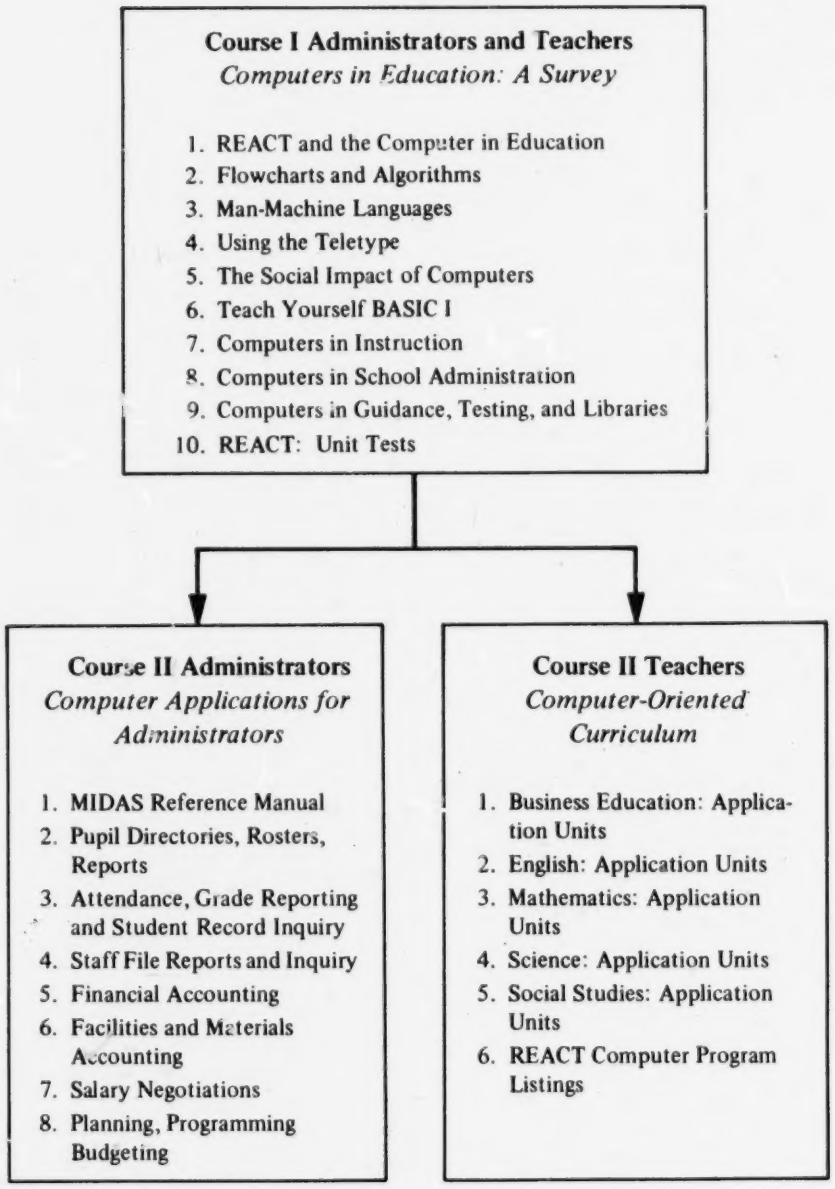
The Computer Utility 9
Information Retrieval 49
Balance of Payments 61
Computer-Written Poetry 77
Interpersonal Relationships 93

Social Studies Data Analysis Tools

Statistical Analysis 99
Best Line Fit for a Set of Points 107

Bibliography 113

REACT COURSE MAP


Course I Administrators and Teachers
Computers in Education: A Survey
1. REACT and the Computer in Education
2. Flowcharts and Algorithms
3. Man-Machine Languages
4. Using the Teletype
5. The Social Impact of Computers
6. Teach Yourself BASIC I
7. Computers in Instruction
8. Computers in School Administration
9. Computers in Guidance, Testing, and Libraries
10. REACT: Unit Tests
Course II Administrators
Computer Applications for Administrators
1. MIDAS Reference Manual
2. Pupil Directories, Rosters, Reports
3. Attendance, Grade Reporting and Student Record Inquiry
4. Staff File Reports and Inquiry
5. Financial Accounting
6. Facilities and Materials Accounting
7. Salary Negotiations
8. Planning, Programming Budgeting
Course II Teachers
Computer-Oriented Curriculum
1. Business Education: Application Units
2. English: Application Units
3. Mathematics: Application Units
4. Science: Application Units
5. Social Studies: Application Units
6. REACT Computer Program Listings

PREFACE

The use of computers in school administration and in instructional programs is fast becoming accepted practice in the academic environment. For administrators, teachers, and students alike, it is imperative that early preparation be provided if full advantage is to be taken of the computer's almost infinite potential. To help such individuals gain a meaningful understanding of the computer is the primary aim of REACT: Relevant Educational Applications of Computer Technology.

REACT was developed by the Northwest Regional Educational Laboratory, under the direction of the United States Office of Education. Instructional courses have been designed, utilizing the parameters developed by the educators who created REACT and emphasizing the concrete demonstration of existing computer applications. These demonstrations provide "hands-on" experience and dramatically increase the computer knowledge and computer skills of school personnel.

Tecnica Education Corporation is currently under an exclusive contract with the Northwest Regional Educational Laboratory to publish and disseminate REACT material and is responsible for conducting the REACT training program for school administrators and teachers. This program of training is currently organized into three courses, each providing thirty hours of instruction. The course materials comprise a total of twenty-four instructional books.

COURSE I: *Computers in Education: A Survey,* introduces both *administrators* and *teachers* to uses of computers in education. Included are such topics as time sharing, introductory programming and the use of different types of applications.

COURSE II: *Computer Applications for Administrators,* permits *administrators* to examine the concept of data management systems by utilizing a demonstration system constructed for a model school. Units in this course range from the routine (preparation of report cards) to the imaginative (a program planning budgeting system).

COURSE II: *Computer-Oriented Curriculum,* for *teachers* is composed of applications units in various subject areas. These units include a description of the computer program, rationale for the unit, ways to inte-

grate the unit with the ongoing curriculum, performance objectives and suggestions for a sequence of class activities during use of the unit.

The REACT program can be presented in a variety of ways. It is flexible enough for use as a semester course or a quarter course. It can be used for a loosely structured in-service workshop, where the materials and equipment are made available for use as the staff has the time and motivation, or it can be offered as an intensive workshop. The course materials can also be used independently for self-study.

Development of the REACT Program

The training program has been developed by NWREL over the past two years, with the support of the U.S. Office of Education. During development and evaluation, the REACT courses and materials were tested in a variety of settings. The program was presented as a graduate course for preparing school administrators at the University of Oregon and at the New York Institute of Technology. It was given as an evening extension course through the Multnomah County (Oregon) Intermediate Education District, and as an in-service program at a small rural school in North Bend, Oregon.

Dr. Kenneth Simon, Director of Dissemination and Installation at NWREL, crystallized the essence of REACT when he said, "These training courses provide an easy and effective method for school personnel anywhere in the United States to gain an understanding of the use of computers and how to apply them in their daily work."

INTRODUCTION

Most people still think of the computer as this generation's calculating machine. They acknowledge that the computer is a valuable tool, but they feel its value must necessarily be restricted to situations which involve only numbers. This popular attitude about computers has tended to alienate teachers of non-mathematical subjects and has restricted the use of the computer almost exclusively to the mathematics and science classrooms.

The past two decades have demonstrated that the computer is far more than a calculator – it is a general instruction-obeying machine. As man has begun to change his attitude toward the computer, the implications for computer use in the social sciences and humanities are beginning to be understood and developed. For example, computers increasingly are being programmed to store and organize large amounts of social data. These data banks can greatly facilitate man's use of data in understanding his society.

Computers have also been programmed as interactive simulation devices. These simulations allow the user to try out certain unfamiliar roles or to see the likely effect of particular decisions before facing similar situations in the real world. The possibilities for using the computer to help man understand himself and the world he lives in are increasingly being recognized and explored.

This book has been organized to point out two of the major applications of computers in the social sciences: simulation and data analyses. The first portion contains a variety of simulation demonstrations. The second part consists of two basic statistical programs which perform the types of calculation and analyses frequently used in social science.

The computer has already demonstrated that it can serve as a valuable laboratory aid in the mathematics and science classrooms even for students and teachers without formal computer training. There is every indication it can also be of considerable assistance in the social studies curriculum.

The units which follow are examples of the computer's tremendous potential for use in the social studies curriculum.

Users are welcome to modify any of the programs in the REACT series. All programs are written in the BASIC language and presently run on Hewlett-Packard computers. All program listings are contained in REACT COMPUTER PROGRAM LISTINGS and may be modified to run on any other computer system.

Program runs and references to line numbers in this book apply to the Hewlett-Packard BASIC programs. Users of other computers may find minor differences, i.e., format of exponential notation. Contact your local computer sales representative for specific details.

THE COMPUTER UTILITY

I. IDENTIFICATION

Subject Area: Social Studies

Specific Topic: The Social Impact of the Computer: The Computer Utility

Grade Level: Twelfth

Program Type: Prepared

Program Name: UTIL

II. DESCRIPTION OF UNIT

Computer Program Materials

The computer program in this unit is an elementary model of a computer-based utility system. It has been designed to demonstrate some of the ways in which a computer system of the not-too-distant future might be able to help man facilitate many of the activities which involve close coordination among various members of society. This particular program demonstrates such a use of the computer with respect to some of the common financial activities which take place among households, retail businesses and banks. The program permits the student to play the role of either a householder, a retail merchant or a banker.

The computer recognizes which of the roles the student has chosen by the utility number the student enters when asked for his utility ID number. If the utility number is one which is recognized by the program, the computer will offer the student the following choices:

1. If the user has entered the number of a *householder,* he can:
    a. Place a purchase order with a retail business to which he has access. Before ordering, the householder can examine the current inventory file of the firm and the retail price of

each item. Once an order is placed, the computer will automatically:

(1) Reduce the customer's bank account by the amount of the purchase. The UTIL program will not allow the customer to overdraw his account.

(2) Increase the merchant's bank account by the amount of the purchase.

(3) Simulate a reorder of any item – should the purchase reduce the merchant's inventory below the reorder point on any particular item – by:

(a) Increasing the inventory by the amount of the order.

(b) Reducing the merchant's bank account by the wholesale price of the order.

(c) Placing a message indicating the order in the merchant's message file.

(4) Increase the customer's and merchant's cumulative purchase files by the amount of the order.

b. Examine his own cumulative purchase file with a particular merchant. The householder has the choice of examining his purchases with a firm either for a particular month or for the year to date.

c. Examine his own bank account or any other account to which he has legal access. The program will print out the running record of the bank account to date.

d. Examine his credit rating with the bank and borrow or pay back funds. The credit rating scheme incorporated in this system is based

on a scale from 0 to 3 with the debt ceiling for immediate bank credit being, respectively:

0 Customer is unable to receive immediate cash credit from the bank at this time.

1 Customer can receive immediate cash credit up to a ceiling of $300.

2 Customer can receive immediate cash credit up to a ceiling of $1000.

3 Customer can receive immediate cash credit up to a ceiling of $5000.

The customer's current debt balance to the bank is maintained within this part of the utility system. The system also allows the customer either to borrow up to his ceiling limit or pay back the principal on his debt.

e. Write a message. The user can send a message to the message file of any other user in the system.

f. Examine his own message file or the file of any other utility number to which he has access. The messages will be printed out by date of entry after any desired date that the user enters.

2. If the user has entered the number of a *retail business*, he can:

a. Examine and/or revise the inventory account of the firm. If the user wishes to examine the inventory, the program will print out for each item:

(1) Item name

(2) Unit of measure.

(3) Retail cost per unit.

(4) Number of units in stock.

(5) Reorder point.

(6) Amount of reorder.

(7) Wholesale cost per unit.

The user is also able to add to the inventory list or to change any of the information in the list.

b. Examine the customer's cumulative purchase file. In this routine the user has the option to:

(1) Examine a particular customer's purchase file for a given month or for the entire year to date.

(2) Examine the purchase file of all customers for a given month or for the entire year to date.

c. Examine his bank account. This routine is identical to the one described for householders.

d. Examine the bank credit rating and borrow or pay back funds. This routine is identical to the one described for householders.

e. Write a message. This routine is identical to the one described for householders.

f. Examine the messages in his file. This routine is identical to the one described for householders.

3. If the user has entered the number of a *banker*, he can:

a. Examine and/or alter a customer's credit rating. The credit system was described earlier. The banker has access to the credit information of all of his clients and can alter the credit positions of his clients.

b. Examine a client's bank account. The banker has access to the account data for all of his clients.

c. Write a message. This routine is identical to the one described for householders.

d. Examine the messages in his file. This routine is identical to the one described for householders.

While the program described here is rather complex, it has been designed to be self-explanatory to the student using it. For additional information with respect to the use of the program and directions for altering the data, refer to the Instructions for Use of the UTIL Program, page 19.

Rationale for Computer Use

One of the reasons the social studies curriculum has done very little thus far in attempting to prepare students for the massive future impact of computer technology is the lack of a concrete and realistic framework within which students can study the social implications of the computer. The program described in this unit provides one such framework. Today's students will undoubtedly be living most of their adult lives using the computer as a routine appliance both at home and at work. The transactions allowed by the program in this unit are not at all unrealistic and in fact are rather modest. Computer consoles in the home linked by phone lines to central computers someday will help the householder to do such things as:

1. Compute his income tax.
2. Decide which of several home loans is the best.
3. Maintain files of important personal information.
4. Keep records of important dates; the computer could type out reminders each morning of important events for that day.
5. Plan balanced menus for the family.
6. Continue his formal education or allow his children to take courses for credit outside of school by

accessing stored computer-aided instruction programs.

7. Access public information files; for example, he will be able to obtain the latest news report or a list of the published books which deal with a particular subject.

These are but a few of the possible future applications of the computer in the home. The critical issues which the social studies curriculum must begin to deal with, however, are not so much these particular applications of the computer, but rather the unprecedented social and moral questions which man faces as the computer becomes more influential in his life. The computer utility program of this unit highlights several of these critical issues; for example, the effect of the computer on the kinds of jobs that will be in demand; the question of who will and should have access to the personal information that will be stored in the computer; the ways in which the computer can change the types and quality of relationships that exist between people in our society; the question of who should make the decisions about whether and in what form information about people will become centralized in a computer, and so forth.

III. INSTRUCTIONAL OBJECTIVES

Having completed this lesson and used the UTIL program, the student will:

1. Express in some appropriate form to others (e.g., an essay, a poem, a painting, a lecture) his feelings about facing a society in which the computer will have increasing influence.
2. Write a critical report about the UTIL computer program, discussing his opinions about:
   a. The kinds of jobs that probably would be eliminated if such a utility system were put into general use.

b. The kinds of jobs that would be created if the utility were put into use.

c. How he, as a student, can go about best preparing himself for a world in which the computer will play an important role and where jobs will continually change due to the computer's role.

3. Think of several ideas for each of the following categories:

a. The advantages of having a computer utility such as the one in the UTIL program.

b. The disadvantages of having such a utility.

c. Other tasks that a computer might be able to do to help a householder, a merchant or a banker.

d. Ways that someone who wanted to sabotage the computer system might be able to do it.

e. Ethical questions which this program suggests that society must face in the near future.

f. The ways in which the manner that the student will spend and save money is likely to differ from those of his parents or his grandparents because of the computer.

4. Argue and defend a point of view on common assertions about the computer and society.

IV. LEARNING SEQUENCE

Prerequisites

The student should know the meaning of the following terms used in the computer program UTIL:

1. Inventory.
2. Retail price.
3. Wholesale price.
4. Credit rating.
5. Reorder point.

Activities

1. Review the procedures for using the stored computer program.
2. Discuss the program with the students and begin to discuss some of the ways in which the computer will affect their lives in the future.
3. Have the students run the program either individually or in small groups. Once they have become familiar with what the program does, have them discuss such questions as the following as they continue to use the program:
   a. If a computer utility like this one actually were in use, in what ways would spending money be different than it is now? Than it was when your parents were your age?
   b. Do you think that cash and checks will ever be eliminated by the computer?
   c. Do you like the way that the bank's credit rating system allows you to borrow money immediately?
      (1) What are some of the possible dangers of doing it this way?
      (2) Who else should be able to find out your credit rating?
      (3) What information should a banker have before he determines what your credit rating is?
   d. What if the computer would suddenly declare your utility number invalid and therefore you cannot prove that you even have a bank account?
      (1) Who do you think would win the argument in court, you or the computer?
      (2) How might such a loss of identity be avoided?
      (3) Because it is conceivable that such a disaster could happen, is it still worth having a utility system such as this?

e. What jobs that you know of would be eliminated or drastically changed if such a computer utility were in use? What new jobs would be created by such a utility?

f. Suppose you wanted to sabotage the system and get some information you were not entitled to have access to. How might you try to do it? What ways can you think of to improve the security of the system?

g. If you were the decision maker for society and had to decide whether a utility system such as this one were to be implemented:

(1) Would you permit it to be implemented?

(2) What questions about the system would you ask the designer?

(3) What pressures against deciding to use the system would you expect to receive and from whom?

(4) What pressures for using the system would you expect to receive and from whom?

(5) What sorts of protections and guarantees would you want for the people most affected by the system, such as those likely to lose their jobs?

(6) How would you try to educate people to use the system most wisely?

h. What additional capabilities would you like to see added to the computer utility to help the householder? What additional capabilities would you not like to see added?

4. Have the students read from several social commentaries concerning the impact of the computer on society. (See Bibliography.)

5. Take a field trip to a large computer installation or review a film about the computer in society. (See Bibliography for a list of films.)
6. Discuss with the students their own feelings about the social impact of the computer; their fears and their hopes for the future.

INSTRUCTIONS FOR USE OF THE UTIL PROGRAM

The home, business and bank utility program utilizes the action of the user as illustrated by the demonstration run. Some basic knowledge is necessary before it is possible to operate the program. The program often makes use of a command known as INPUT. This allows the user to enter answers to questions initialized by the computer program.

RESPONSES TO QUESTIONS

In order for the program to run successfully, the response to a question presented by the computer must be in the correct form; incorrect spelling may result in an incorrect response by the computer. There are many instances where an answer of YES or NO is required. In all but a very few cases, any response except a NO will be interpreted as a YES response.

When asked for the number of an option, the entry of any number except one of those in the choices will result in an error message from the computer. At the end of a completed routine, often the following message will appear:

```
DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT THIS TIME?
```

If the user types NO, then the program will terminate.

If the user types CHANGE, he will be allowed to enter a new utility identification number. This allows the user to make transactions while playing one role and then change to another role without terminating the program. Termination of the program will erase the record of transactions for that run.

For example, the user could initially enter a home utility number and place a purchase order with a business which would cause an item in the business inventory to be reordered. Then the user could type CHANGE and enter the business utility number of the business from which he ordered as a householder. He could check the inventory and his bank account to see how the purchase has affected his various accounts.

Any answer other than NO or CHANGE will be interpreted as a YES command, giving the user the choice of selecting a bank, business or home utility option, depending upon what type of utility number he previously entered. These options are printed only once, when the user enters his desired utility identification number. After the first time, the program merely asks for his choice of an option. However, if the user desires to see the options again, he may type a 0 (zero) and obtain a new listing of the options.

It is very important that the user be able to distinguish between the use of the numerical zero and the alphabetical O. These two characters are *not* interchangeable when working with the program. The user must remember to use the character which is correct whether it be numerical or alphabetical.

CAUTIONS

There are several other cautions to be heeded when entering answers during the operation of the program. Usually the computer will not yield the correct results when a negative amount of money is entered. The user must also avoid the impulse to try to pay back an amount which is greater than his initial debt.

In the program there is another very important fact which must be considered: answers involving only numbers are treated differently from answers involving words and combinations of letters and numbers. In an answer involving only numbers, spaces do not make any difference and the user should not be alarmed if he accidentally puts a space where he did not intend to have one. However, answers involving combinations of letters and numbers tend to be tempermental and frequently cause problems. If the answer begins with a number, the whole answer must be enclosed in quotation marks. As long as the answer does not begin with a number, quotation marks are not necessary. When dealing with combinations of letters and numbers, spaces imbedded within the answer become part of the answer as it is stored in the computer. Those spaces on the outside of the answer are ignored unless they are enclosed in quotation marks along with the rest of the answer.

If the user wishes to terminate the program while printing is taking place, he merely has to hit the BREAK key.

DESCRIPTION OF UTILITY NUMBERS AND ACCESSIBILITY

Names and associated utility numbers are:

Bank #1 – 101.
Bank #2 – 102.
Grocery -- 201.
Hardware – 202.
John Smith – 301.
Vikki Cohen – 302.
Steve Jones – 303.

Bank #1 has access to the accounts and credit ratings of:

1. Hardware.
2. John Smith.
3. Vikki Cohen.

Bank #2 has access to the accounts and credit ratings of:

1. Grocery.
2. Vikki Cohen.
3. Steve Jones.

The grocery has access to:

1. His account at bank #2.
2. His credit rating at bank #2.
3. His own inventory and price list.
4. The purchase files of:
   a. John Smith.
   b. Vikki Cohen.
   c. Steve Jones.

The hardware has access to:

1. His account at bank #1.

2. His credit rating at bank #1.
3. His own inventory and price list.
4. The purchase files of:
   a. John Smith.
   b. Steve Jones.

John Smith has access to:

1. His account at bank #1.
2. His credit rating at bank #1.
3. His own purchase files at the grocery and the hardware.
4. The ordering routines for the grocery and the hardware.

Vikki Cohen has access to:

1. Her accounts at bank #1 and bank #2.
2. Her credit ratings at bank #1 and bank #2.
3. Her own purchase file at the grocery.
4. The ordering routine for the grocery.

Steve Jones has access to:

1. His account at bank #2.
2. His credit rating at bank #2.
3. His own purchase files at the grocery and the hardware.
4. The ordering routines for the grocery and the hardware.

Each utility has access to the message files of the other utilities. The user is able to write a message to any file, but he is able to examine only the messages to his own file.

INSTRUCTIONS FOR THE ALTERATION OF DATA

The use of the UTIL program can be varied by changing the number of banks, businesses and homes, changing the debt ceiling, etc. Changing the program would give the user more flexibility in using the program in the classroom. If it is desired to make changes to the program,

the user may wish to refer to the program listing of UTIL in REACT COMPUTER PROGRAM LISTINGS while reading the following explanations.

The lines containing data are located at the end of the program and are documented with REM statements. In this section, each type of data will be considered in relation to use and alteration. In some cases, alteration of the data requires a great deal of change in the program itself, so it is not advisable. Whenever alteration is possible without a great deal of work, it will be discussed, even though it may be impractical.

Section One. The first section contains the number of bank, business and home utilities, respectively. The first number in line 23400 is the number of banks. The second number is the number of businesses. The third number is the number of homes. The work required to change the number of utility numbers in any category is ridiculous when compared to the advantages obtained. The necessary alterations would require the knowledge of a programmer or someone who knew the program quite well.

Section Two. The second section contains the utility numbers of each bank, business and home. The numbers in line 23600 are the bank utility numbers. The numbers in line 23800 are the business utility numbers. The numbers in line 24000 are the home utility numbers. It is not possible to make changes in this section without first making changes in the first section, which was already discussed.

Section Three. The third section contains the number of bank, business and home utilities accessible by each utility. Line 24200 contains the banks accessible by each utility. Line 24400 contains the number of businesses accessible by each utility. Line 24600 contains the number of homes accessible by each utility. By using the following example, the format of the third section can be discussed:

```
24100 REM NUMBER OF BANKS ACCESSIBLE BY EACH
      UTILITY
24200 DATA 1,1,1,1,1,2,1
```

In the example above, the first two numbers represent the number of banks accessible by bank #1 and bank #2, respectively. The third and

fourth numbers represent the number of banks accessible by the grocery and the hardware, respectively. The fifth, sixth and seventh numbers represent the number of banks accessible by John Smith, Vikki Cohen and Steve Jones, respectively. The same format applies to lines 24400 and 24600. In order to change the number of utilities accessible by each utility, the user must change the appropriate number in section three and also in the other sections which apply.

Section Four. The fourth section contains the utility numbers accessible by each utility number. There are three sub-sections to this section. The first sub-section contains lines 24800, 25000 and 25200. These lines correspond to the first line in section three.

The next two groups of three data lines also correspond to the second and third lines of section three, respectively. The following example illustrates the format of this section:

```
25100 REM NUMBER OF BANKS ACCESSIBLE BY EACH
      HOME
25200 DATA 101,101,102,102
```

By looking in section three, line 24200, it is evident that the homes have access to one, two and one bank, respectively. The first number in line 25200 is the bank number accessible by John Smith. The next two numbers are the bank numbers accessible by Vikki Cohen. The last number is the bank number accessible by Steve Jones. Changes in this section occur only along with changes in section three. The proper utility number must be inserted in the proper line according to the change made in section three.

Section Five. The fifth section contains the credit ratings and debts of each business and home at each bank. If the business or home does not have a bank account at a bank, it still gets a credit rating and debt for that bank, although they are both equal to zero. If one of the businesses or homes obtains a bank account at a bank where it did not previously have one, the user must merely insert the desired credit rating and debt in the appropriate data line. The data lines for this section are lines 26500 through 28400. The first number in each line is the credit rating and the second number is the debt. The credit rating system is explained in the credit section of the program

Section Six. The sixth section of the program contains the debt ceilings for the credit section of the program. These can easily be changed if the user desires. The first number is the debt ceiling for a credit rating of 1. The second number is the debt ceiling for a credit rating of 2. The third number is the debt ceiling for a credit rating of 3. These numbers and all monetary amounts in this program are expressed in cents. For example, $3.00 is expressed as 300 throughout the program. This applies to responses made by the user as well as data which is already stored in the computer. When changing the debt ceilings, it must be remembered that bank customers with credit ratings corresponding to a certain debt ceiling must not have debts which exceed the debt ceiling.

Section Seven. The seventh section contains the number of bank transactions for each business and home. The following is the data line which is associated with this section:

```
28800 DATA -1,5,4,5,-1,4,-1,-1,5,4
```

The first five numbers correspond to bank #1 and the second five numbers correspond to bank #2. The first two numbers in each group of five correspond to the transactions for the grocery and the hardware, respectively. The last three numbers in each group correspond to the transactions for John Smith, Vikki Cohen and Steve Jones, respectively. If the utility number does not have an account at the bank, then a −1 has been placed where a positive number would otherwise be if the utility number had an account at the bank. In order to change the number of transactions for an account at a certain bank, the user must make sure that the business or home does actually have an account at the bank. Then additional transactions must be added to section eight. If a business or home is being given access to a new bank, then transactions must be provided for that utility number at the bank. The number of transactions must also be entered in section seven.

Section Eight. The eighth section contains the transactions for each business and home at each bank. If the utility number does not have an account at a bank, then there is a REM statement which states this fact. It will be found in the appropriate place in the data section of the program. The lines which contain transactions are lines 28900 through

35200. The transactions are arranged according to the order in section seven. There are two basic groups corresponding to bank #1 and bank #2. Each of these groups either contains transactions for each business and home or else it contains a REM statement which states that the particular utility number does not have an account at the bank. When changes are made in this section, they must be accompanied by the appropriate changes in section seven. There must be the same number of transactions as is specified in section seven. An example of the format of this section follows:

```
31000 REM TRANSACTIONS FOR VIKKI COHEN AT BANK #1
31100 DATA "08-12-69"
31200 DATA 0,1990,27074
```

The data in line 31100 is a string variable and is the same as a word. It is the date that the particular transaction has taken place. The first number in line 31200 is the debit for the transaction. The second number is the credit for the transaction. The third number is the balance after the transaction has taken place. As before, these numbers represent the number of cents. For example, the second number in line 31200 represents $19.90. When a transaction is added to a customer's account, it must be placed so that the dates for the account are in chronological order. Ample space has been provided for additions in any part of the data section. Each new transaction must contain one line with the date in quotation marks and one line with the debit, credit and balance. As in the example, if only the credit part is present, then the debit will be zero and must be represented by a zero in the debit position.

Section Nine. The ninth section contains the number of messages to each file. The first two numbers in line 35400 represent the number of messages to bank #1 and bank #2, respectively. The third and fourth numbers represent the number of messages to the grocery and the hardware, respectively. The last three numbers represent the number of messages to John Smith, Vikki Cohen and Steve Jones, respectively. Any change in this section must also include a change in section ten.

Section Ten. The tenth section contains the messages to each file. The messages are arranged in the same order as the numbers in section nine. The following example shows the format of the tenth section.

```
35500 REM MESSAGES TO BANK #1
35600 DATA "05-10-69"
35700 DATA "REQUEST CHECKS"
35800 DATA "JOHN SMITH"
```

When changing data in this section, note that one message must contain three parts. The first line of the new message must contain the date it was written. The second line must contain the message. The third line must contain the source of the message. When placing the new message in the data section, it must be in the appropriate file and it must be in a position which will keep all of the messages to the file in chronological order. When a new message is added, the number of messages to the file must be increased in section nine.

Section Eleven. The eleventh section contains the names of the utility numbers. They are arranged in the order of the utility numbers in section two. The bank and business names are in line 43200 and the home names in line 43300. This section cannot be altered without alteration of section one, which was already discussed.

Section Twelve. The twelfth section contains the number of items in the inventories of the grocery and the hardware. In order to alter the data in line 43500, the user must make corresponding changes in section thirteen. An addition in section twelve must be accompanied by an addition in section thirteen. The first number in line 43500 is the number of items in the grocery inventory and the second number is the number of items in the hardware inventory.

Section Thirteen. The thirteenth section contains the items in the inventories of the grocery store and the hardware store. The following example will illustrate the format of this section:

```
43600 REM ITEMS IN GROCERY INVENTORY
43700 DATA "BREAD","LOAF",33,15,10,12,20
```

The first word in line 43700 is the name of the item. The second word is the unit of purchase. The first number in line 43700 is the retail cost of the item in cents. The second number is the number of units in stock. The third number is the reorder point for the item. The fourth number is the amount of reorder for the item. The fifth number is the

wholesale cost of the item per unit in cents. When an item is added to the inventory of one of the businesses, the number of items in the inventory must be increased in section twelve and the data for the item must be entered under the appropriate business. It does not make any difference what order the items are in as long as they are under the proper business. The addition of an item also requires changes in section fourteen. A purchase file must be provided for each customer for each item that is added.

Section Fourteen. The fourteenth section contains the purchase files of the customers for each business. The data lines associated with this section are lines 45100 through 52800. The following example will illustrate the format of this section.

```
45100 REM JOHN SMITH PURCHASES AT GROCERY-BREAD
45200 DATA 0,1,2,0,1,3,2,0,1,3,2,1
```

The REM statement tells the name of the customer, the name of the business and the name of the item. The data line contains the number of purchases for each month during the year. The first number in line 45200 is the number of purchases for the first month, and so on. The first half of this section is the purchase files for the grocery store. The second half of the section is the purchase files for the hardware store. Within each of these halves, there is one third devoted to the purchases of each customer, even if he does not have access to the business, as in the case of Vikki Cohen at the hardware store. The purchases for each customer for each item at each business are arranged in the same order as the items in section thirteen. An addition in section thirteen must be accompanied by the addition of a purchase file for each customer for the item. The purchase file must be in the same position with respect to the other purchase files for the business as the item is with respect to the other items in section thirteen.

DEMONSTRATION RUN – UTIL

```
RUN

UTIL


WHEN ANSWERING QUESTIONS WHICH DO NOT ASK FOR
AN OPTION, TYPE YES OR NO AND PRESS THE RETURN
BUTTON.ANY OTHER ANSWER WILL BE INTERPRETED
AS A YES COMMAND. WHEN CHOOSING AN OPTION,
PICK THE NUMBER OF THE OPTION AND PRESS THE
RETURN BUTTON.
PRINT THE PRESENT DATE IN THE FORM 00-00-00
USING QUOTATION MARKS.
WHAT IS THE DATE?"12-02-69"

DO YOU WISH TO SEE AN INTRODUCTORY DESCRIPTION
OF THE UTILITY PROGRAM?YES

THIS PROGRAM IS AN ELEMENTARY MODEL OF A
COMPUTER BASED UTILITY SYSTEM. IT HAS BEEN
DESIGNED TO DEMONSTRATE SOME OF THE WAYS IN
WHICH A COMPUTER SYSTEM OF THE NOT TOO DISTANT
FUTURE MIGHT BE ABLE TO HELP MAN FACILITATE
MANY OF THE ACTIVITIES WHICH INVOLVE CLOSE
COORDINATION AMONG VARIOUS MEMBERS OF SOCIETY.
THIS PARTICULAR PROGRAM DEMONSTRATES SUCH A USE
OF THE COMPUTER WITH RESPECT TO SOME OF THE
COMMON FINANCIAL ACTIVITIES WHICH TRANSPIRE
AMONG HOUSEHOLDS, BUSINESSES, AND BANKS.
HOPEFULLY BY USING THIS PROGRAM YOU WILL COME
TO THINK MORE SERIOUSLY AND KNOWLEDGEABLY ABOUT
SOME OF THE TREMENDOUS POSSIBILITIES OF USING
THE COMPUTER AS THE BASIS OF SOCIAL UTILITY
SYSTEMS. ALSO, HOPEFULLY, YOU WILL BEGIN TO
THINK MORE SERIOUSLY ABOUT SOME OF THE SOCIAL
IMPLICATIONS, FOR EXAMPLE, THE IMPLICATIONS ON
WORK, OF SUCH COMPUTER BASED SYSTEMS.
```

```
WHAT IS YOUR UTILITY NUMBER? 302 (Vikki Cohen)

THE FOLLOWING ARE THE HOME OPTIONS AVAILABLE TO
YOU:
1. PLACE A PURCHASE ORDER
2. EXAMINE A CUMULATIVE PURCHASE FILE
3. EXAMINE YOUR BANK ACCOUNT
4. EXAMINE BANK CREDIT RATING: BORROW OR PAY
BACK FUNDS
5. WRITE A MESSAGE
6. EXAMINE THE MESSAGES TO YOUR FILE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE? 1 (Place a purchase order)

WHAT IS THE UTILITY NUMBER OF THE FIRM WHERE YOU
WISH TO PLACE AN ORDER? 201 (Grocery)

DO YOU WISH TO SEE THE CURRENT INVENTORY AND PRICE
LIST OF THE FIRM? YES

BUSINESS: GROCERY

          ITEM                    RETAIL
ITEM#     NAME          UNIT      COST/UNIT

  1       BREAD         LOAF      $0.33
  2       MILK          QUART     $0.27
  3       CHEESE        POUND     $1.65
  4       GND BEEF      POUND     $0.69
  5       CEREAL        BOX       $0.47
  6       SUGAR         10 LB     $0.89
  7       BUTTER        POUND     $0.39

HOW MANY DISTINCT ITEMS DO YOU WISH TO ORDER?
7

WHAT IS THE UTILITY NUMBER OF THE BANK WITH
WHICH YOU WISH TO COMPLETE THE TRANSACTION?
102 (Bank #2)

WHAT IS THE 1 ST ITEM NUMBER? 2 (Milk)
WHAT QUANTITY DO YOU WISH TO ORDER? 3
```

```
WHAT IS THE 2 ND ITEM NUMBER? 3 (Cheese)
WHAT QUANTITY DO YOU WISH TO ORDER? 1

WHAT IS THE 3 RD ITEM NUMBER? 1 (Bread)
WHAT QUANTITY DO YOU WISH TO ORDER? 2

WHAT IS THE 4 TH ITEM NUMBER? 5 (Cereal)
WHAT QUANTITY DO YOU WISH TO ORDER? 1

WHAT IS THE 5 TH ITEM NUMBER? 7 (Butter)
WHAT QUANTITY DO YOU WISH TO ORDER? 4

WHAT IS THE 6 TH ITEM NUMBER? 6 (Sugar)
WHAT QUANTITY DO YOU WISH TO ORDER? 1

WHAT IS THE 7 TH ITEM NUMBER? 4 (Ground Beef)
WHAT QUANTITY DO YOU WISH TO ORDER? 2

YOUR TOTAL BILL FOR THIS ORDER IS $7.42
YOUR NEW BALANCE WILL BE $268.02

DO YOU WISH TO EXECUTE THE ORDER? YES
WHAT IS THE NUMBER OF THE PRESENT MONTH? 12

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT
THIS TIME? YES

WHAT IS THE NUMBER OF THE HOME OPTION WHICH YOU
CHOOSE? 2 (Examine a cumulative purchase file)

WHAT IS THE UTILITY NUMBER OF THE FIRM? 201 (Grocery)

THE FOLLOWING ARE THE OPTIONS OPEN TO YOU:
1. EXAMINE YOUR PURCHASE TOTAL BY MONTH
2. EXAMINE YOUR YEARLY PURCHASE TOTAL TO DATE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE? 1

WHAT IS THE ITEM NUMBER YOU WISH TO CHECK? 2 (Milk)

WHAT IS THE NUMBER OF THE MONTH YOU ARE
INTERESTED IN? 12
```

```
BUSINESS: GROCERY

NAME: VIKKI COHEN
ITEM: MILK
UNIT: QUART
MONTH NUMBER: 12
NUMBER OF PURCHASES: 5

DO YOU WISH TO CHECK ANY OTHER MONTHS FOR THIS
ITEM?YES

WHAT IS THE NUMBER OF THE MONTH YOU ARE INTERESTED
IN?6

BUSINESS: GROCERY

NAME: VIKKI COHEN
ITEM: MILK
UNIT: QUART
MONTH NUMBER: 6
NUMBER OF PURCHASES: 0

DO YOU WISH TO CHECK ANY OTHER MONTHS FOR THIS
ITEM?NO

DO YOU WISH TO CHECK ANY OTHER ITEMS FOR THIS
FILE?YES

WHAT IS THE ITEM NUMBER YOU WISH TO CHECK?7 (Butter)

WHAT IS THE NUMBER OF THE MONTH YOU ARE INTERESTED
IN?12

BUSINESS: GROCERY

NAME: VIKKI COHEN
ITEM: BUTTER
UNIT: POUND
MONTH NUMBER: 12
NUMBER OF PURCHASES: 6

DO YOU WISH TO CHECK ANY OTHER MONTHS FOR THIS
ITEM?YES
```

```
WHAT IS THE NUMBER OF THE MONTH YOU ARE
INTERESTED IN?4

BUSINESS: GROCERY

NAME: VIKKI COHEN
ITEM: BUTTER
UNIT: POUND
MONTH NUMBER: 4
NUMBER OF PURCHASES: 1

DO YOU WISH TO CHECK ANY OTHER MONTHS FOR THIS
ITEM?NO

DO YOU WISH TO CHECK ANY OTHER ITEMS FOR THIS
FILE?NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE HOME OPTION WHICH YOU
CHOOSE?2  (Examine a cumulative purchase file)

WHAT IS THE UTILITY NUMBER OF THE FIRM?201  (Grocery)

THE FOLLOWING ARE THE OPTIONS OPEN TO YOU:
1. EXAMINE YOUR PURCHASE TOTAL BY MONTH
2. EXAMINE YOUR YEARLY PURCHASE TOTAL TO DATE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE?2  (Examine yearly purchase total to date)

WHAT IS THE ITEM NUMBER YOU WISH TO CHECK?5  (Cereal)
WHAT IS THE NUMBER OF THE PRESENT MONTH?12

BUSINESS: GROCERY

NAME: VIKKI COHEN
ITEM: CEREAL
UNIT: BOX
```

```
MONTH NUMBER      NUMBER OF PURCHASES

      1                    1
      4                    1
      9                    1
      10                   1
      11                   2
      12                   2

TOTAL YEARLY PURCHASES: 8

DO YOU WISH TO CHECK ANY OTHER ITEMS?YES

WHAT IS THE ITEM NUMBER YOU WISH TO CHECK? 3 (Cheese)
WHAT IS THE NUMBER OF THE PRESENT MONTH? 12

BUSINESS: GROCERY

NAME: VIKKI COHEN
ITEM: CHEESE
UNIT: POUND

MONTH NUMBER      NUMBER OF PURCHASES

      1                    1
      2                    2
      3                    3
      4                    1
      5                    2
      6                    3
      7                    2
      8                    3
      9                    3
      10                   2
      11                   1
      12                   3

TOTAL YEARLY PURCHASES:26

DO YOU WISH TO CHECK ANY OTHER ITEMS?NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT
THIS TIME?YES
```

WHAT IS THE NUMBER OF THE HOME OPTION WHICH YOU CHOOSE?3 (Examine your bank account)

WHAT IS THE UTILITY NUMBER OF THE BANK WHERE YOU WISH TO SEE YOUR BANK ACCOUNT?102 (Bank #2)

BANK #2

DATE	DEBIT	CREDIT	BALANCE
06-21-69	$0.00	$49.83	$201.12
06-28-69	$17.14	$0.00	$183.98
07-13-69	$29.78	$0.00	$154.20
08-11-69	$0.00	$25.83	$180.03
09-12-69	$0.00	$95.41	$275.44
12-02-69	$7.42	$0.00	$268.02

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT THIS TIME?YES

WHAT IS THE NUMBER OF THE HOME OPTION WHICH YOU CHOOSE?0 (Requests a list of options)

THE FOLLOWING ARE THE HOME OPTIONS AVAILABLE TO YOU:
1. PLACE A PURCHASE ORDER
2. EXAMINE A CUMULATIVE PURCHASE FILE
3. EXAMINE YOUR BANK ACCOUNT
4. EXAMINE YOUR BANK CREDIT RATING: BORROW OR PAY BACK FUNDS
5. WRITE A MESSAGE
6. EXAMINE THE MESSAGES TO YOUR FILE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU CHOOSE?4 (Examine credit rating, etc.)

DO YOU WISH TO SEE AN EXPLANATION OF THE CREDIT RATING SYSTEM?YES

```
        THE CREDIT RATING ASPECT OF THIS UTILITY
ALLOWS THE BANKER AND THE INDIVIDUAL BANK CUSTOMER
TO REMAIN IN CLOSE AND CONTINUOUS COMMMUNICATION
CONCERNING THE INDIVIDUAL'S CREDIT POSITION WITH
THE BANK. THE CREDIT RATING SCHEME IS BASED ON AN
INTEGER SCALE FROM 0 TO 3 WITH THE DEBT CEILING
FOR IMMEDIATE CREDIT BEING RESPECTIVELY:

     0: CUSTOMER IS UNABLE TO RECEIVE IMMEDIATE
        CREDIT FROM THE BANK AT THIS TIME.

     1: CUSTOMER CAN RECEIVE IMMEDIATE CASH
        CREDIT UP TO A CEILING OF $300.

     2: CUSTOMER CAN RECEIVE IMMEDIATE CASH
        CREDIT UP TO A CEILING OF $1000.

     3: CUSTOMER CAN RECEIVE IMMEDIATE CASH
        CREDIT UP TO A CEILING OF $5000.

     THE CUSTOMER'S CURRENT DEBT BALANCE TO
THE BANK IS MAINTAINED WITHIN THIS PART OF THE
UTILITY SYSTEM AND THE SYSTEM ALSO ALLOWS THE
CUSTOMER EITHER TO BORROW UP TO HIS CEILING
LIMIT OR PAY BACK PRINCIPLE ON HIS DEBT.

WHAT IS THE UTILITY NUMBER OF THE BANK WHERE
YOU WISH TO CHECK YOUR CREDIT? 102   (Bank #2)

YOUR CREDIT RATING AT BANK #2 IS 3
THERE IS A CURRENT DEBT OF $3503.00

THE FOLLOWING OPTIONS ARE AVAILABLE TO YOU:
1.LEAVE THIS PART OF THE PROGRAM
2.BORROW ADDITIONAL FUNDS
3.REPAY PART OR ALL OF THE DEBT PRINCIPLE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE? 2   (Borrow)

HOW MUCH DO YOU WISH TO BORROW? $250.00

THE TRANSACTION HAS BEEN COMPLETED.
```

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE HOME OPTION WHICH
YOU CHOOSE?4 (Examine credit rating, etc.)

DO YOU WISH TO SEE AN EXPLANATION OF THE CREDIT
RATING SYSTEM?NO

WHAT IS THE UTILITY NUMBER OF THE BANK WHERE
YOU WISH TO CHECK YOUR CREDIT?102

YOUR CREDIT RATING AT BANK #2 IS 3
THERE IS A CURRENT DEBT OF $3753.00

THE FOLLOWING OPTIONS ARE AVAILABLE TO YOU:
1.LEAVE THIS PART OF THE PROGRAM
2.BORROW ADDITIONAL FUNDS
3.REPAY PART OR ALL OF THE DEBT PRINCIPLE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE?3 (Repay)

HOW MUCH DO YOU WISH TO PAY BACK?$83.50

THE TRANSACTION HAS BEEN COMPLETED.

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE HOME OPTION WHICH YOU
CHOOSE?3 (Examine your bank account)

WHAT IS THE UTILITY NUMBER OF THE BANK WHERE
YOU WISH TO SEE YOUR BANK ACCOUNT?102

```
BANK #2

  DATE        DEBIT       CREDIT      BALANCE

06-21-69      $0.00       $49.83      $201.12
06-28-69      $17.14      $0.00       $183.98
07-13-69      $29.78      $0.00       $154.20
08-11-69      $0.00       $25.83      $180.03
09-12-69      $0.00       $95.41      $275.44
12-02-69      $7.42       $0.00       $268.02
12-02-69      $0.00       $250.00     $518.02
12-02-69      $83.50      $0.00       $434.52

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE HOME OPTION WHICH YOU
CHOOSE?5  (Write a message)

WHAT IS THE UTILITY NUMBER OF THE FILE TO WHICH
YOU WISH TO WRITE A MESSAGE?102  (Bank #2)

TYPE THE MESSAGE WITHIN THE QUOTATION MARKS WHICH
WILL FOLLOW.
WHAT IS THE MESSAGE?"SEND BANK STATEMENT"

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE HOME OPTION WHICH YOU
CHOOSE?6  (Examine messages to your file)

THIS ROUTINE WILL PRINT OUT ALL MESSAGES AFTER A
GIVEN DATE. ENTER THE REFERENCE DATE IN THE
FORM 00-00-00 USING QUOTATION MARKS.
WHAT IS THE DATE DESIRED?"06-23-69"

  DATE        MESSAGE                 SOURCE OF MESSAGE

11-03-69      ACCOUNT OVERDRAWN       BANK #2
11-15-69      31 NOT AVAILABLE        GROCERY

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT
THIS TIME?CHANGE
```

Note: The user is now able to change his utility number. The following is an illustration of the options available to a business.

```
WHAT IS YOUR UTILITY IDENTIFICATION NUMBER?201

THE FOLLOWING ARE THE BUSINESS OPTIONS
AVAILABLE TO YOU:
1. EXAMINE AND/OR REVISE THE INVENTORY ACCOUNT
2. EXAMINE THE CUSTOMER'S CUMULATIVE PURCHASE
   FILE
3. EXAMINE YOUR BANK ACCOUNT
4. WRITE A MESSAGE
5. EXAMINE THE MESSAGES TO YOUR FILE
6. EXAMINE BANK CREDIT RATING: BORROW OR PAY
   BACK FUNDS

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE? 1  (Examine and/or revise inventory account)

DO YOU WISH TO EXAMINE THE INVENTORY ACCOUNT?YES

GROCERY

ITEM #   ITEM NAME   UNIT    RETAIL COST/ UNIT   #OF UNITS IN STOCK   REORDER POINT   AMOUNT OF REORDER   WHOLESALE COST/UNIT
1        BREAD       LOAF    $0.33               13                   10              12                  $0.20
2        MILK        QUART   $0.27               21                   15              10                  $0.15
3        CHEESE      POUND   $1.65               20                   12              10                  $1.02
4        GND BEEF    POUND   $0.69               23                   15              20                  $0.42
5        CEREAL      BOX     $0.47               41                   20              30                  $0.23
6        SUGAR       10 LB   $0.89               16                   12              10                  $0.58
7        BUTTER      POUND   $0.39               29                   20              20                  $0.18

THE FOLLOWING OPTIONS ARE OPEN TO YOU:
1. LEAVE THIS PART OF THE PROGRAM
2. CREATE A NEW INVENTORY FILE
3. REVISE AN OLD INVENTORY FILE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE?2  (Create a new inventory file)

WHAT IS THE NAME OF THE ITEM?JAM
```

```
WHAT IS THE UNIT WHICH THE ITEM COMES IN?JAR
WHAT IS THE RETAIL COST PER UNIT?$.59
HOW MANY UNITS ARE IN STOCK?34
WHAT IS THE REORDER POINT?16
WHAT IS THE AMOUNT OF REORDER?30
WHAT IS THE WHOLESALE COST PER UNIT?$.28

DO YOU WISH TO WORK ANY FURTHER WITH THE
INVENTORY FILE?YES

THE FOLLOWING OPTIONS ARE OPEN TO YOU:
1.LEAVE THIS PART OF THE PROGRAM
2.CREATE A NEW INVENTORY FILE
3.REVISE AN OLD INVENTORY FILE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE?3  (Revise an old inventory file)

WHAT IS THE ITEM NUMBER OF THE FILE YOU WISH
TO REVISE?6  (Sugar)
WHAT IS THE CATEGORY NUMBER OF THE CELL YOU
WISH TO REVISE?3  (Retail cost/unit)
WHAT IS THE CELL VALUE?$.99  (New price for 10 lb sugar)

DO YOU WISH TO REVISE ANY MORE OF THE CELLS
UNDER THIS SAME ITEM?NO

DO YOU WISH TO MAKE ANY MORE REVISIONS IN THE
INVENTORY ACCOUNT?NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE BUSINESS OPTION
WHICH YOU CHOOSE?2  (Examine the customer's cumulative purchase file)

THE FOLLOWING OPTIONS ARE OPEN TO YOU:
1.EXAMINE A CUSTOMER'S CUMULATIVE PURCHASES
  BY MONTH
2.EXAMINE THE TOTAL PURCHASES OF A CUSTOMER
3.EXAMINE MONTHLY PURCHASES ACROSS CUSTOMERS
4.EXAMINE YEARLY PURCHASES ACROSS CUSTOMERS
```

```
WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE?1

WHAT IS THE UTILITY NUMBER OF THE ACCOUNT YOU
WISH TO EXAMINE?301  (John Smith)

WHAT IS THE ITEM NUMBER YOU WISH TO CHECK?4 (Ground Beef)
WHAT IS THE NUMBER OF THE MONTH YOU ARE
INTERESTED IN?7

BUSINESS: GROCERY

NAME: JOHN SMITH
ITEM: GND BEEF
UNIT: POUND
MONTH: 7
NUMBER OF PURCHASES: 3

DO YOU WISH TO CHECK ANY OTHER MONTHS FOR
THIS ITEM?NO

DO YOU WISH TO CHECK ANY OTHER ITEMS FOR
THIS FILE?NO

DO YOU WISH TO EXAMINE ANY OTHER CUSTOMER'S
ACCOUNTS?NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE BUSINESS OPTION
WHICH YOU CHOOSE?2

THE FOLLOWING OPTIONS ARE OPEN TO YOU:
1. EXAMINE A CUSTOMER'S CUMULATIVE PURCHASES
   BY MONTH
2. EXAMINE THE TOTAL PURCHASES OF A CUSTOMER
3. EXAMINE MONTHLY PURCHASES ACROSS CUSTOMERS
4. EXAMINE YEARLY PURCHASES ACROSS CUSTOMERS

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE?2  (Examine the total purchases of a customer)
```

```
WHAT IS THE UTILITY NUMBER OF THE ACCOUNT
YOU WISH TO EXAMINE? 303  (Steve Jones)

WHAT IS THE ITEM NUMBER YOU WISH TO
CHECK? 2  (Milk)
WHAT IS THE NUMBER OF THE PRESENT MONTH? 12

BUSINESS: GROCERY

NAME: STEVE JONES
ITEM: MILK
UNIT: QUART

MONTH NUMBER      NUMBER OF PURCHASES

      1                   1
      3                   3
      4                   2
      5                   1
      6                   3
      8                   1
      9                   1
      11                  1
      12                  1

TOTAL YEARLY PURCHASES: 14

DO YOU WISH TO CHECK ANY OTHER ITEMS? NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME? YES

WHAT IS THE NUMBER OF THE BUSINESS OPTION WHICH
YOU CHOOSE? 2

THE FOLLOWING OPTIONS ARE OPEN TO YOU:
1. EXAMINE A CUSTOMER'S CUMULATIVE PURCHASES
BY MONTH
2. EXAMINE THE TOTAL PURCHASES OF A CUSTOMER
3. EXAMINE MONTHLY PURCHASES ACROSS CUSTOMERS
4. EXAMINE YEARLY PURCHASES ACROSS CUSTOMERS

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE? 3  (Examine monthly purchases across customers)
```

```
WHAT IS THE ITEM NUMBER YOU WISH TO CHECK? 6 (Sugar)
WHAT IS THE NUMBER OF THE MONTH YOU ARE
INTERESTED IN? 10

BUSINESS: GROCERY

NAME: JOHN SMITH
ITEM: SUGAR
UNIT: 10 LB
MONTH NUMBER: 10
NUMBER OF PURCHASES: 0

NAME: VIKKI COHEN
ITEM: SUGAR
UNIT: 10 LB
MONTH NUMBER: 10
NUMBER OF PURCHASES: 1

NAME: STEVE JONES
ITEM: SUGAR
UNIT: 10 LB
MONTH NUMBER: 10
NUMBER OF PURCHASES: 1

DO YOU WISH TO CHECK ANY OTHER MONTHS FOR THIS
ITEM?NO
DO YOU WISH TO CHECK ANY OTHER ITEMS?NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE BUSINESS OPTION WHICH
YOU CHOOSE? 2

THE FOLLOWING OPTIONS ARE OPEN TO YOU:
1. EXAMINE A CUSTOMER'S CUMULATIVE PURCHASES BY
   MONTH
2. EXAMINE THE TOTAL PURCHASES OF A CUSTOMER
3. EXAMINE MONTHLY PURCHASES ACROSS CUSTOMERS
4. EXAMINE YEARLY PURCHASES ACROSS CUSTOMERS

WHAT IS THE NUMBER OF THE OPTION WHICH YOU
CHOOSE? 4 (Examine yearly purchases across customers)
```

```
WHAT IS THE ITEM NUMBER YOU WISH TO CHECK? 5 (Cereal)
WHAT IS THE NUMBER OF THE PRESENT MONTH? 12

BUSINESS: GROCERY

NAME: JOHN SMITH
ITEM: CEREAL
UNIT: BOX

MONTH NUMBER      NUMBER OF PURCHASES

      2                    1
      3                    2
      5                    2
      6                    1
      7                    4
      10                   2
      11                   1
      12                   2

TOTAL YEARLY PURCHASES: 15

NAME: VIKKI COHEN
ITEM: CEREAL
UNIT: BOX

MONTH NUMBER      NUMBER OF PURCHASES

      1                    1
      4                    1
      9                    1
      10                   1
      11                   2
      12                   2

TOTAL YEARLY PURCHASES: 8

NAME: STEVE JONES
ITEM: CEREAL
UNIT: BOX
```

MONTH NUMBER	NUMBER OF PURCHASES
1	1
4	1
5	1
7	1
8	1
9	1
11	2
12	1

TOTAL YEARLY PURCHASES: 9

DO YOU WISH TO CHECK ANY OTHER ITEMS?NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT THIS TIME?YES

WHAT IS THE NUMBER OF THE BUSINESS OPTION WHICH YOU CHOOSE?6 (Examine bank credit rating, etc.)

DO YOU WISH TO SEE AN EXPLANATION OF THE CREDIT RATING SYSTEM?NO

WHAT IS THE UTILITY NUMBER OF THE BANK WHERE YOU WISH TO CHECK YOUR CREDIT?102

YOUR CREDIT RATING AT BANK #2 IS 2
THERE IS A CURRENT DEBT OF $800.00

THE FOLLOWING OPTIONS ARE AVAILABLE TO YOU:
1.LEAVE THIS PART OF THE PROGRAM
2.BORROW ADDITIONAL FUNDS
3.REPAY PART OR ALL OF THE DEBT PRINCIPLE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU CHOOSE?3 (Repay)

HOW MUCH DO YOU WISH TO PAY BACK?$132.50

THE TRANSACTION HAS BEEN COMPLETED.

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT THIS TIME?YES

```
WHAT IS THE NUMBER OF THE BUSINESS OPTION
WHICH YOU CHOOSE?3  (Examine your bank account)

WHAT IS THE UTILITY NUMBER OF THE BANK WHERE
YOU WISH TO SEE YOUR BANK ACCOUNT?102

BANK #2

  DATE        DEBIT        CREDIT       BALANCE

05-14-69      $31.39       $0.00        $339.31
05-19-69      $83.79       $0.00        $255.52
06-09-69      $0.00        $29.17       $284.69
10-15-69      $76.83       $0.00        $207.86
12-02-69      $132.50      $0.00        $75.36

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE BUSINESS OPTION WHICH
YOU CHOOSE?5  (Examine the messages to your file)

THIS ROUTINE WILL PRINT OUT ALL MESSAGES AFTER A
GIVEN DATE. ENTER THE REFERENCE DATE IN THE
FORM 00-00-00 USING QUOTATION MARKS.
WHAT IS THE DATE DESIRED?"04-20-69"

  DATE     MESSAGE                        SOURCE OF MESSAGE

05-14-69   REQUEST BALANCE STATEMENT      VIKKI COHEN
05-25-69   ORDER BRAND 3 BREAD            JOHN SMITH
06-03-69   MAKE LOAN PAYMENT              BANK #2

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?CHANGE
```

Note: The next page is the beginning of an illustration of the options available to a bank.

WHAT IS YOUR UTILITY IDENTIFICATION NUMBER?
102 (Bank #2)

THE FOLLOWING ARE THE BANK OPTIONS AVAILABLE TO YOU:
1. EXAMINE AND/OR ALTER A CUSTOMER'S CREDIT RATING
2. EXAMINE CUSTOMER'S BANK ACCOUNT
3. WRITE A MESSAGE
4. EXAMINE THE MESSAGES TO YOUR FILE

WHAT IS THE NUMBER OF THE OPTION WHICH YOU CHOOSE? 1 (Examine and/or alter credit rating)

DO YOU WISH TO SEE AN EXPLANATION OF THE CREDIT RATING SYSTEM?NO

WHAT IS THE UTILITY NUMBER OF THE ACCOUNT YOU WISH TO EXAMINE? 201 (Grocery)

THE PRESENT CREDIT RATING FOR THIS ACCOUNT IS 2
THERE IS A CURRENT DEBT OF $667.50

DO YOU WISH TO CHANGE THE RATING?YES
WHAT IS THE NEW RATING? 3 (Increases the credit ceiling to $5000.00)

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM AT THIS TIME?YES

WHAT IS THE NUMBER OF THE BANK OPTION WHICH YOU CHOOSE? 2 (Examine customer's bank account)

WHAT IS THE UTILITY NUMBER OF THE ACCOUNT WHICH YOU WISH TO EXAMINE? 303

STEVE JONES

DATE	DEBIT	CREDIT	BALANCE
08-11-69	$57.26	$0.00	$323.58
09-27-69	$45.44	$0.00	$278.14
10-08-69	$0.00	$30.64	$308.78
11-21-69	$8.85	$0.00	$299.93

```
DO YOU WISH TO EXAMINE ANY OTHER ACCOUNTS?NO

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?YES

WHAT IS THE NUMBER OF THE BANK OPTION WHICH
YOU CHOOSE? 4  (Examine the messages to your file)

THIS ROUTINE WILL PRINT OUT ALL MESSAGES
AFTER A GIVEN DATE. ENTER THE REFERENCE DATE
IN  THE FORM 00-00-00 USING QUOTATION MARKS.
WHAT IS THE DATE DESIRED?"08-20-69"

  DATE     MESSAGE                        SOURCE OF MESSAGE

11-05-69   REQUEST ACCOUNT STATEMENT      VIKKI COHEN
11-05-69   REQUEST BALANCE STATEMENT      GROCERY
12-02-69   SEND BANK STATEMENT            VIKKI COHEN

DO YOU WISH TO MAKE FURTHER USE OF THE SYSTEM
AT THIS TIME?NO
```

INFORMATION RETRIEVAL

I. IDENTIFICATION

Subject Area: Social Studies

Specific Topic: The Social Impact of the Computer: Information Retrieval

Grade Level: Twelfth

Program Type: Prepared

Program Name: INFO

II. DESCRIPTION OF UNIT

Computer Program Materials

The computer program contained in this unit is an elementary model of an information processing and retrieval system. It has been designed to demonstrate some of the ways a computer can help man to organize, control and take advantage of the mass of information at his disposal today.

The program has also been designed to highlight some of the opportunities for misuse of computerized data files and the real social dangers that are possible should our society be careless about the ways it chooses to use the information processing capabilities of the computer. The particular information system of the INFO program stores and processes information about hypothetical students. The following data is stored about each student.

1. Name.
2. ID number.
3. Age.
4. Class year.
5. Grade point average.
6. Rank in class.
7. Yearly family income.
8. Number of arrests.

9. Number of school suspensions.
10. Whether the student has received psychiatric help.
11. Whether the student is known to have used drugs.
12. Whether the parents are divorced.
13. Sex of the student.

Information can be retrieved from the file in three different ways:

1. A student's entire file or a sub-set of that file.
2. A count (and a list if desired) of the students who satisfy a certain set of conditions; if more than one condition is imposed, *all* of the conditions must be satisfied. (For example, one might wish to know the number of students who are in at least the third year of school, have a grade point average higher than 3.0 and have been suspended from school at least once.)
3. Certain types of information that require elementary processing by the computer; these requests can also be coupled with conditions as in mode 2. (For example, one might ask for the average family income of all those students who rank lower than 50th in their class and who have been arrested at least twice.)

The program requires no previous experience with information retrieval systems to be used successfully. It has been specifically designed for instructional purposes rather than as an optimally efficient retrieval system.

Rationale for Computer Use

The computer is expanding man's capacity to organize, process and retrieve information to a degree hardly imaginable by most of us. Nearly every institution of any size in this country is already at least planning to develop information retrieval systems to centralize and improve the efficiency of handling data within the institution. Large regional and na-

tional data systems are being developed, such as regional educational data banks and various medical and legal library retrieval systems. The federal government has also developed huge computer-based data systems to process the national census and internal revenue information.

The social advantages of this accelerating movement toward the centralization of information in computers are tremendous. For example, if personal data about individuals in this country could be stored in a computer that was readily accessible by people dealing with the critical social problems confronting the nation, then invaluable statistical information that is not now available to decision makers could be brought to bear on these problems. The advantages are so strong that the Bureau of the Budget has already formally proposed the creation of a National Data Bank to pool information now guarded by 20 federal agencies.

The pervasive pressure today for geater centralization of personal information has created what many people feel to be *the* most crucial problem involving the computer's impact on society. In its most extreme form this fear is expressed in terms of the big brother state of Orwell's *1984*.

Heretofore in our society sensitive personal data about an individual has been kept in separate manual files: birth records were stored in one place, school records in other places, census information somewhere else and personal financial information and police records in yet other files. Such a dispersion of personal information provided inherent guarantees of privacy; the records of one's past tended to be self-destructive since it has been generally too costly to collect and analyze this information.

The prospect of centralizing personal information about an individual virtually destroys these inherent guarantees and raises serious ehtical, moral and legal questions which the next generation of adults must be prepared to answer.

The INFO program written for this unit provides an elementary, but personal and realistic, framework within which stu-

dents can begin to grapple with some of these questions. For example, the data file for the INFO program contains personal information about hypothetical students. Some of this information would be considered by most students to be public; other information would be considered semi-public in the sense that some people might have legitimate access to it, but certainly not everyone; and finally, there is some very private information stored in the files.

The various retrieval routines, however, demonstrate that the answers to the centralized file problem are not quite as simple as merely excluding private information from the files. The system allows certain statistical processing of this raw data without associating it with particular names. Such analyses of private information may well be extremely valuable to society and worth some risk in allowing the information to be stored.

III. INSTRUCTIONAL OBJECTIVES

After completing this unit and using the INFO program, the student will be able to:

1. List at least five examples of information retrieval systems already in existence that have been developed to aid an institution, a region of the country or the government in processing personal information.
2. List arguments for each of the following:
   a. Three in favor of the establishment of a National Data Center.
   b. Three against the establishment of a National Data Center.
3. Write a well-reasoned one- or two-page essay taking a position on the question of establishing a National Data Center; in the essay the student will defend three of the arguments he gave for No. 2 above and refute the other three.
4. List at least three major weaknesses of the INFO retrieval system which would lead to eventual misuse of

the system; suggest methods that would correct these weaknesses.

5. Carry out a project related to computer processing of personal information.

IV. LEARNING SEQUENCE

Prerequisites

There are no prerequisites for this unit.

Activities

1. Review with the students the procedures for using a stored computer program.
2. Have the students use the INFO program several times, retrieving information from the system in various ways, such as:
   a. A student's entire file.
   b. The grade point average of a particular student.
   c. The number of students who satisfy the following conditions:
      (1) A grade point average less than 2.0.
      (2) Parents are divorced.
      (3) Have used drugs.
   d. The names of those male students:
      (1) Whose yearly family income is less than $5,000.
      (2) Who have received psychiatric help.
   e. The mean grade point average for those students who have been suspended at least twice.
3. After each use of the system have the students discuss among themselves how they feel about that particular information being stored and available, covering such questions as:

a. Who should and should not have access to that particular information?

b. How might you improve the system to guarantee limited access of certain information (such as the requirement of user codes similar to the ones in the UTIL program)?

c. What data, if any, should not be able to be associated with particular names but might be legitimate to store if access were restricted to statistical uses of the data?

d. How would they feel knowing such data were stored in a computer even though they were assured that basic rights of privacy were guaranteed?

4. Based on class readings, films, field trips (see Bibliography), discuss the major arguments:

   a. In favor of developing a National Data Center.

   b. Against developing a National Data Center.

5. Have the students draw up a set of guidelines which they think should govern the development of a National Data Center if one were established.

DEMONSTRATION RUN – INFO

```
THIS PROGRAM HAS THE FOLLOWING OPTIONS:
    1. CREATE A NEW FILE
    2. REVISE AN OLD FILE
    3. LIST ALL OR PART OF A FILE
    4. SEARCH FILES FOR CERTAIN CONDITIONS
    5. SEARCH FILES AND PERFORM CALCULATIONS
    6. DESCRIPTION OF OPTIONS 1 THRU 5 ABOVE
    7. LIST FILE CATEGORIES
    8. DESCRIPTION OF THE RETRIEVAL SYSTEM
    9. STOP THE PROGRAM

WHICH OPTION?8


'INFO' IS A SIMULATED INFORMATION RETRIEVAL SYSTEM TO BE
USED WITH STUDENT FILES.  WHEN USING 'INFO', YOU MAY -
     *  RETRIEVE AN INDIVIDUAL STUDENT'S FILE
     *  CONSTRUCT A COUNT OF STUDENTS WHO SATISFY A SET
        OF GIVEN CONDITIONS
     *  CREATE A NEW FILE ON A STUDENT
     *  REVISE AN OLD FILE.

THIS PROGRAM IS AN ELEMENTARY MODEL OF AN INFORMATION
PROCESSING AND RETRIEVAL SYSTEM. IT HAS BEEN DESIGNED
TO DEMONSTRATE SOME OF THE KINDS OF WAYS THAT A COMPUTER
CAN HELP MAN TO ORGANIZE, CONTROL, AND TAKE ADVANTAGE OF
THE MASS OF INFORMATION AT HIS DISPOSAL TODAY. HOPEFULLY
BY USING THIS PROGRAM YOU WILL COME TO THINK MORE
SERIOUSLY AND KNOWLEDGEABLY ABOUT SOME OF THE TREMENDOUS
POSSIBILITIES THERE ARE FOR COMPUTERS AS INFORMATION
PROCESSORS.  ALSO HOPEFULLY, YOU WILL BEGIN TO THINK
JUST AS SERIOUSLY AND KNOWLEDGEABLY ABOUT THE REAL SOCIAL
DANGERS SHOULD MAN BE CARELESS ABOUT THE WAY HE CHOOSES
TO USE INFORMATION PROCESSING CAPABILITIES OF THE
COMPUTER.
```

```
WHICH OPTION?7

                FILE FORMAT DESCRIPTION


     1          2   3   4    5    6    7   8  9  10 11 12 13
-------------------------------------------------------------
PHILLIPS,SUE   8371  14  1  3.81  1  5300  0  0   N  Y  N  F
-------------------------------------------------------------
ROBERTS,HAL    9723  16  3  2.76 32  8500  1  2   Y  N  Y  M

1 NAME                                  7 FAMILY INCOME (YEARLY)
2 I.D. NUMBER                           8 ARRESTS
3 AGE                                   9 SUSPENSIONS
4 CLASS YEAR (FROSH = 1,               10 RECEIVED PSYCHIATRIC HELP?
   SOPH = 2, JR = 3, SR = 4)           11 USED DRUGS?
5 GRADE POINT AVERAGE                  12 PARENTS DIVORCED?
6 RANK IN CLASS                        13 SEX

IT WILL AID YOU IN USING THIS PROGRAM IF YOU THINK OF THE
DATA AS BEING STORED IN THE COMPUTER ACCORDING TO THE MATRIX
ABOVE, AND THAT THE DATA IN A PARTICULAR CELL IS DENOTED
AS F(A,B) WHERE 'A' IS THE ROW NUMBER AND 'B' IS THE COLUMN
NUMBER. THUS, FOR EXAMPLE, IN THE MATRIX ABOVE F(2,8)=1
AND F(2,1)=ROBERTS,HAL. SINCE IT IS EASIER FOR THE COMPUTER TO
MANIPULATE NUMBERS THAN WORDS, THE PROGRAM OCCASIONALLY WILL
ASK YOU TO INDICATE THE PARTICULAR FILE CATEGORY NUMBER THAT
YOU ARE INTERESTED IN. THUS, FOR EXAMPLE, A STUDENT'S RANK
IN CLASS IS FILE CATEGORY NUMBER 6 AND THE FAMILY'S ANNUAL
INCOME IS FILE CATEGORY NUMBER 7.

WHICH OPTION?6


  OPTION 1. CREATE A NEW FILE
ENTER DATA AS COMPUTER ASKS FOR EACH CATEGORY.
  OPTION 2. REVISE AN OLD FILE
ENTER I.D. NUMBER, CATEGORY NUMBER AND DATA TO BE
REVISED AS COMPUTER ASKS.
  OPTION 3. LIST ALL OR PART OF A FILE
TO LIST ALL OF A FILE ENTER YES WHEN ASKED.  WHEN
LISTING PART OF A FILE, ENTER HOW MANY CATEGORIES
```

ARE WANTED, THEN THEIR NUMBERS ON SEPARATE LINES.
OPTION 4. SEARCH FILES FOR CERTAIN CONDITIONS
THE FILES MAY BE SEARCHED FOR CONDITIONS IN ONE OR MORE CATEGORIES. FILE VALUES MAY BE COMPARED TO A REFERENCE VALUE (GREATER, LESS, OR EQUAL) OR CHOSEN TO BE YES-NO OR MALE-FEMALE. IF MORE THAN ONE CONDITION IS IMPOSED, ALL OF THE CONDITIONS MUST BE SATISFIED. FOR EXAMPLE, YOU MIGHT WISH TO KNOW THE STUDENTS WHO ARE IN AT LEAST THE THIRD YEAR, AND HAVE BEEN SUSPENDED AT LEAST ONCE.
OPTION 5. SEARCH FILES AND PERFORM CALCULATION
THE CALCULATIONS THAT CAN BE PERFORMED ARE TO FIND THE LARGEST OR SMALLEST VALUE, OR FIND THE TOTAL OR AVERAGE OF THE VALUES IN A CATEGORY. IF ALL THE STUDENTS ARE TO BE INCLUDED IN THE CALCULATION, ANSWER 'NO' TO THE CONDITIONAL CATEGORIES QUESTION. HOWEVER, CONDITIONS MAY BE IMPOSED JUST LIKE IN OPTION 4 TO LIMIT THE SEARCH. FOR EXAMPLE, YOU MIGHT ASK FOR THE AVERAGE G.P.A. OF MALE STUDENTS WHO HAVE BEEN ARRESTED AT LEAST TWICE.

WHICH OPTION? 1

STUDENT NAME? PAUL

I.D.NUMBER? 14

AGE? 17

CLASS YEAR? 4

G.P.A.? 3.90

RANK IN CLASS? 6

AVERAGE YEARLY INCOME OF FAMILY? 9874

NUMBER OF ARRESTS? 0

NUMBER OF SUSPENSIONS? 0

RECEIVED PSYCHIATRIC HELP? YES

USED DRUGS? NO

```
PARENTS DIVORCED?NO
SEX?MALE
WHICH OPTION?3
I.D. NUMBER?14
LIST ALL THE FILE?YES
STUDENT NAME : PAUL
I.D. NUMBER : 14
AGE : 17
CLASS YEAR : 4
G.P.A. : 3.9
RANK IN CLASS : 6
AVERAGE YEARLY INCOME OF FAMILY : $ 9874
NUMBER OF ARRESTS : 0
NUMBER OF SUSPENSIONS : 0
HAS RECEIVED PSYCHIATRIC HELP.
HAS NOT USED DRUGS.
PARENTS ARE NOT DIVORCED.
SEX : MALE

ANOTHER FILE?NO
WHICH OPTION?2

I.D. NUMBER?14
```

```
CATEGORY NUMBER? 10

RECEIVED PSYCHIATRIC HELP?NO

ANOTHER REVISION IN THIS PERSONS FILE?NO


WHICH OPTION? 3

I.D. NUMBER? 14

LIST ALL THE FILE?NO

HOW MANY CATEGORIES? 3

LIST THE NUMBERS OF THE CATEGORIES.
?1
?10
?12

STUDENT NAME : PAUL

HAS NOT RECEIVED PSYCHIATRIC HELP.

PARENTS ARE NOT DIVORCED.


ANOTHER FILE?NO


WHICH OPTION? 4

HOW MANY CATEGORIES? 3

CATEGORY NUMBER? 3
REFERENCE VALUE? 14
EQUAL, GREATER, OR LESS THAN REFERENCE VALUE? GREATER

CATEGORY NUMBER? 11
YES OR NO?YES

CATEGORY NUMBER? 5
REFERENCE VALUE? 2.86
GREATER OR LESS THAN REFERENCE VALUE? LESS
```

```
THESE CRITERIA SELECT THE FOLLOWING 2     STUDENTS:
FRED      # 2
JUDY      # 4


WHICH OPTION?5


IMPOSE CONDITIONAL CATEGORIES?YES

HOW MANY CATEGORIES?2

CATEGORY NUMBER?6
REFERENCE VALUE?70
GREATER OR LESS THAN REFERENCE VALUE?LESS

CATEGORY NUMBER?12
YES OR NO?YES
THE ONLY STUDENT WHO SATISFIES ALL THE CRITERIA IS JOHN     # 3

WHICH OPTION?5


IMPOSE CONDITIONAL CATEGORIES?YES

HOW MANY CATEGORIES?2

CATEGORY NUMBER?6
REFERENCE VALUE?70
GREATER OR LESS THAN REFERENCE VALUE?LESS

CATEGORY NUMBER?12
YES OR NO?NO

CATEGORY FOR CALCULATION?7

LARGEST, SMALLEST, OR AVERAGE?LARGEST
THE LARGEST VALUE IS ASSOCIATED WITH
MARY      # 1
THE VALUE IS 8040

WHICH OPTION?9

DONE
```

BALANCE OF PAYMENTS

I. IDENTIFICATION

Subject Area: Economics

Specific Topic: International Balance of Payments

Grade Level: Twelfth

Program Type: Prepared

Program Name: BALPAY

II. DESCRIPTION OF UNIT

Computer Program Materials

The computer program of this unit is a decision-making game. The user plays the role of decision maker for a hypothetical country. He finds that this country is currently in a very poor balance-of-payments position: either an unhealthy surplus or a serious deficit position. The objective of the game is for the user to make decisions that will give the country a healthy balance-of-payments position within a specified number of years.

Rationale for Computer Use

It is becoming increasingly important for students to graduate from secondary school with a basic understanding of economic principles, particularly principles which affect this country's relationship to other nations. Unfortunately, it has heretofore been extremely difficult to teach these principles to high school students.

The underlying forces governing a country's balance-of-payments position are quite abstract, and there has been no way to give these forces any concrete context for the students. By placing the student in a game situation, he can investigate personally the relationships between policy decisions and their ultimate effects on the economy. The game also provides an automatic self-evaluation for the student – the de-

gree to which he is able to bring the country's balance of payments into a more healthy position is a measure of his understanding of these fundamental economic principles.

III. INSTRUCTIONAL OBJECTIVES

Having used the BALPAY program in the context of this unit, the student will be able to:

1. Play the BALPAY game successfully for both a balance-of-payments deficit and surplus, given the following initial constraints:
   a. An initial ratio of "Net Surplus or Deficit/Net Inflow" which will be one of these:
      (1) Less than –0.20 if a deficit.
      (2) Greater than 0.20 if a surplus.
   b. A game success interval of –0.03 to 0.03.
   c. At least four possible types of policy decisions.
   d. A game time of not more than four years.
2. State in concise paragraphs the effect that each of the following policy decisions tends to have on the country's balance-of-payments position:
   a. An increase (decrease) in the taxes imposed by the government on private investment abroad.
   b. An increase (decrease) in the tariffs imposed by a country on imports from another country.
   c. An increase (decrease) in the amount of government spending abroad.
   d. An increase (decrease) in the prime interest rate in the country.
3. State in concise paragraphs the effect that each of the following events is likely to have on the country's balance-of-payments position:
   a. The devaluation of the currency of another country.
   b. The immediate withdrawal of the country's personnel from another country.

c. The decision by another country to impose harsh economic restrictions on private investments or goods from the country.

IV. LEARNING SEQUENCE

Prerequisites

The student should know how to call up and use a stored computer program. Understanding of such terms as balance of payments, surplus, deficit, tariff, prime interest rate, devaluation of currency, and economic restrictions.

Activities

1. Discuss with the students the general problem of balance of payments. In particular discuss the meaning of the following terms used in the BALPAY program:
   a. Balance of international payments.
   b. Payment deficit.
   c. Payment surplus.
   d. Imports.
   e. Exports.
   f. Foreign investment.
   g. Taxes on investments abroad.
   h. Tariffs.
   i. Prime interest rate.
   j. To devalue currency.
2. Discuss the BALPAY game with the students. Make sure they understand the game and what is expected of them. Also discuss with them certain particulars about entering policy decisions; for example, they should know that a decrease of ten percent in the percentage change of an item is entered into the computer as *–10* while an increase of the same percentage is entered as *10*.
3. Have the students play the game several times. A good strategy here might be to divide the class into teams to

play the game. Encourage the teams to discuss among themselves such issues as:

a. Their strategy; their hypotheses about the effect of certain decisions on the balance of payments.

b. The effect certain contingencies, which are built into the game, have on the balance-of-payments position. The contingencies are:

   (1) A revolution in Peru.

   (2) The devaluation of the English pound.

   (3) The easing of tensions in the Middle East.

c. The general effect of decisions on the entries in the balance sheet; for example, some strategies for alleviating a payment deficit that are successful as far as the game objective is concerned also serve to reduce both inflows and outflows by a considerable amount. Should the decision maker be concerned when this happens?

V. SUGGESTED EXTENSIONS AND FURTHER STUDY

The BALPAY program has been organized so that it is a relatively easy matter to alter the key variables of the program, including the mathematical model that controls how various policy decisions will affect the items in the balance statement. This aspect of the program allows you to extend the use of BALPAY considerably. For example, BALPAY could serve as a focus for an interdisciplinary unit involving both mathematics and social studies. The mathematical model used in the program is quite simple and involves only the use of linear functions. Students who have taken one year of algebra will have studied linear functions sufficiently to understand the model.

The class or individual students could undertake projects such as those described below:

The first project is for students to obtain U.S. balance-of-payments statements for several years in succession, together with information about policy decisions that the country actually did

make during that period. The task is to alter the game and the mathematical model underlying the game so that a user who made policy decisions similar to the decisions actually made by the country would affect the *game's* balance-of-payments position in a way that closely approximates the results that actually occurred.

This project is probably appropriate only for talented groups of students and will require the aid of a mathematics teacher, but the experience would undoubtedly be quite valuable. The students would be developing a mathematical model for events in the physical world. Such an exercise would deepen their understanding of the economics concepts involved as well as demonstrate some of the power that mathematics can offer to the other disciplines. Also, the experience should serve to rid the students of the natural but dangerous tendency to vest almost absolute authority and accuracy in what the computer prints out.

A second possible project would be to study the effects of contingencies other than the three provided for in the game. For example, several students could study the probable effects of a depression in Japan on the U.S. balance-of-payments position. The students could demonstrate their understanding of the effects of such a contingency by replacing one of the prepared contingency routines already in the program with one of their own involving a simulated depression in Japan.

A third possibility is to study how the balance of payments is affected by another possible policy decision, such as adjusting the income tax rate or leveling a surcharge on taxes. Again the students could demonstrate their understanding of the effects of such a policy decision by incorporating this policy into the game.

NOTES

TECHNICAL INFORMATION ABOUT BALPAY

The BALPAY game has been organized to facilitate altering key variables in the program. The game can be made easier or harder to match the age and ability of the students as well as the particular instructional objectives. If it is desired to make changes to the program, the reader may wish to refer to the program listing of BALPAY in the REACT COMPUTER PROGRAM LISTINGS while reading the following explanations.

THE BASIC GAME VARIABLES

The following variables are easily altered:

1. **The game time period.** Notice that in the prepared version of the game the time period is four years. This may be changed to any number of years you wish or can even be set up so that each time the game is played the computer will choose a random number of years between two and eight.

2. **The game success interval.** This is a particularly critical instructional variable. Notice that the interval in the prepared version of the game is –0.03 to 0.03. You may wish to expand this interval to, say, –0.10 to 0.10 for less able classes or if you wish to give students more chance for success during early attempts at the game. On the other hand, if you have particularly able students, you might want to define success as a game result falling within the interval –0.01 to 0.01.

3. **The initial balance statement entry values.** The initial balance-of-payments statement in the prepared game represents an abridgement of the 1959 U.S. Balance-of-Payments Statement. The entries, however, can and should be changed in order to provide students with a variety of deficit and surplus situations.

Changes in the values of the variables described above can be made simply by replacing particular statements in the BALPAY program. This procedure is done as follows: Access the BALPAY program just as if you were going to run the program. Then you enter the new statement. For example, notice that statement 170 is:

```
170 LET K = M = L = 4
```

This particular statement stores the number of years to the game. Suppose you wished to increase the number of years to five; you enter the two statements:

```
165 K = 5
170 M = L = 4
```

Instructions for making the changes discussed are provided in the following table:

Sample

Old Instruction	*New Instruction*	Intent of the New Instruction
170 LET K=M=L=4	165 K=5 170 M=L=4	To change game time period to three years.
180 LET P=N=3	175 P=5 180 N=3	To change game success interval from -0.03,0.03 to -0.05, 0.05.
2610 DATA 19073,2153,902	2610 DATA 21254,1945,1012	To change initial account values for the inflow statement.
2620 DATA 18271,1610,4745,2375	2620 DATA 20563,1895,2713,1381	To change initial account values for the outflow statement.

Note: It is not necessary to read beyond this point to make effective use of the game.

MATHEMATICAL MODEL UNDERLYING THE BALPAY PROGRAM

As was stated earlier in the text, the mathematical model involved in describing the relationships between policy decisions and the balance-of-payment account entries is rather elementary; all of these relationships are described as linear functions.

For example, suppose we represent the old value for net foreign investment by I_o and the new value by I_N. Also suppose that we represent the declared percentage change in the tariff rate by r. The relationship between the new value for net foreign investment and the old value can therefore be represented by the following linear function:

$$I_N = I_o + A \cdot r \cdot I_o$$

where A represents some coefficient of effect which has been previously determined and stored in the computer. In this way it is possible to alter the mathematical model merely by changing the various coefficients of effect.

The coefficients that are governing the prepared program are also stored in the program as statements **2640** through **2670**. These four statements correspond, respectively, to the policy items of statements **1370 – 1440**. Thus the statement:

```
2640 DATA-.05,-.08,-.8,0,.02,0,0,-5
```

contains the coefficients of effect for the policy item TAXES ON INVESTMENTS ABROAD. These coefficients in turn correspond to the items of the inflow and outflow statements, respectively. In statement **2640** the number .02 is the coefficient of effect for the outflow items IMPORTS: GOODS AND SERVICES. Should you or your students desire to change the particular model of the prepared program, all you need to do is to enter new data statements with the appropriate coefficients.

A word needs to be said concerning the validity of the particular model that has been incorporated in the prepared game. This model has face validity, and the patterns of effect on the items in the balance-of-payments statement are reasonably accurate. However, the model has yet to be given an adequate test. You are encouraged to try to improve this model with your students and *not* accept it as the final word.

CONTINGENCIES

As was mentioned earlier, three contingencies are built into the game:

1. A revolution in Peru.
2. The devaluation of the English pound.
3. The easing of tensions in the Middle East.

The program allows for only three contingencies, but the particular ones involved can be changed quite easily. To define a new contingency, all you would have to do is change the textual material in one of three program paragraphs (**1650, 1780, 1900**) and the appropriate coefficients of effect for contingencies.

DEMONSTRATION RUN – BALPAY

```
RUN
BALPAY

DO YOU WANT A DESCRIPTION OF THIS GAME?YES

THIS COMPUTER PROGRAM IS A DECISION MAKING GAME.
YOUR PART IN THE GAME IS THAT OF DECISION MAKER
FOR THE COUNTRY.  ASSUME THAT THE COUNTRY IS CURRENTLY
IN A VERY POOR BALANCE OF PAYMENTS POSITION.  YOUR
OBJECTIVE IS TO MAKE DECISIONS THAT WILL GIVE THE
COUNTRY A HEALTHY BALANCE OF PAYMENTS POSITION WITHIN  4      YEARS.


BALANCE STATEMENT IN MILLIONS OF DOLLARS - YEAR 0


INFLOWS

EXPORTS      GOODS & SERVICES     $ 19 073
EXPENDITURES FOREIGN TOURIST      $  2 153
INCOME       INVESTMENT           $    902

NET INFLOW    $ 22128


OUTFLOWS


IMPORTS      GOODS & SERVICES     $ 18 271
EXPENDITURES TOURISTS ABROAD      $  1 610
FOREIGN AID & MILITARY AID        $  4 745
INVESTMENTS FOREIGN               $  2 375

NET OUTFLOW    $ 27001


NET SURPLUS(+) OR DEFICIT(-)    -4873

NET SURPLUS OR DEFICIT/NET INFLOW    -.23
```

```
AS YOU CAN SEE FOR THE STATEMENT ABOVE, OUTFLOWS
EXCEED INFLOWS BY A SUBSTANTIAL AMOUNT:  YOUR COUNTRY
IS IN A SERIOUS DEFICIT POSITION.  SHOULD THE DEFICIT
CONTINUE FOR LONG, YOUR COUNTRY'S GOLD RESERVES WOULD
BE DEPLETED.  ALSO TOO MUCH OF YOUR COUNTRY'S RESOURCES
AND PRODUCTION ARE PROBABLY BEING SENT OUT OF THE COUNTRY


FOR THE PURPOSES OF THIS GAME, A 'HEALTHY' BALANCE OF
PAYMENTS POSITION IS DEFINED AS ONE IN WHICH THE VALUE
OF THE RATIO, 'NET SURPLUS OF DEFICIT/NET INFLOW' IS
BETWEEN THE VALUES OF -.03        AND  .03        .  NOTICE
THAT THE CURRENT VALUE OF THIS RATIO IS -.23



ENGLAND HAS REVALUED ITS CURRENCY.  THE ENGLISH GOVERNMENT
WILL NOW PURCHASE AND SELL GOLD FOR 5 SHILLINGS MORE AN
OUNCE.  THIS MOVE IN EFFECT HAS INCREASED THE VALUE OF YOUR
CURRENCY RELATIVE TO ENGLAND'S.  THERFORE GOODS MANUFACTURED
IN YOUR COUNTRY ARE NOW MORE EXPENSIVE TO THE ENGLISH
PEOPLE AND ENGLISH GOODS ARE LESS EXPENSIVE TO YOU.



ENTER YOUR POLICY DECISIONS FOR YEAR  1

WHAT PERCENT CHANGE DO YOU WISH
IN TAXES ON INVESTMENTS ABROAD?3
IN THE TARIFF RATE?4.5
IN GOVERNMENT SPENDING ABROAD?-5
IN THE PRIME INTEREST RATE?.5


BALANCE STATEMENT - YEAR 1


INFLOWS

EXPORTS          $ 18 099
EXPENDITURES     $  2 112
INCOME           $    870

NET INFLOW    $ 21081
```

OUTFLOWS

IMPORTS	$ 15 746
EXPENDITURES	$ 1 598
FOREIGN AID	$ 4 507
INVESTMENTS	$ 1 899
NET OUTFLOW	$ 23750
$ DIFFERENCE	-2669
% DIFFERENCE	-.13

THERE HAS BEEN A REVOLUTION IN PERU. THE NEW GOVERNMENT HAS TAKEN OVER ALL OF THE INDUSTRY CONTROLLED BY FOREIGN INVESTORS. ALSO HARSH RESTRICTIONS HAVE BEEN IMPOSED ON IMPORTS FROM YOUR COUNTRY.

ENTER YOUR POLICY DECISIONS FOR YEAR 2

WHAT PERCENT CHANGE DO YOU WISH
IN TAXES ON INVESTMENTS ABROAD?-5
IN THE TARIFF RATE?0
IN GOVERNMENT SPENDING ABROAD?5
IN THE PRIME INTEREST RATE?-.4

BALANCE STATEMENT - YEAR 2

INFLOWS

EXPORTS	$ 18 165
EXPENDITURES	$ 2 120
INCOME	$ 901
NET INFLOW	$ 21186

```
OUTFLOWS


IMPORTS          $ 15 958
EXPENDITURES     $  1 629
FOREIGN AID      $  4 826
INVESTMENTS      $  2 429

NET OUTFLOW      $ 24842


$ DIFFERENCE    -3656

% DIFFERENCE    -.18

BECAUSE OF THE RELAXING OF TENSIONS IN THE MIDDLE EAST
YOUR COUNTRY HAS DECIDED TO BRING HOME 75,000 TROOPS
NOW STATIONED OUTSIDE OF THE COUNTRY.


ENTER YOUR POLICY DECISIONS FOR YEAR  3

WHAT PERCENT CHANGE DO YOU WISH
IN TAXES ON INVESTMENTS ABROAD?21

YOUR POLICY DECISION IS TOO DRASTIC AND WOULD
CAUSE SERIOUS ECONOMIC PROBLEMS IN YOUR COUNTRY

ENTER ANOTHER DECISION.

IN TAXES ON INVESTMENTS ABROAD?6
IN THE TARIFF RATE?-5
IN GOVERNMENT SPENDING ABROAD?-7
IN THE PRIME INTEREST RATE?0


BALANCE STATEMENT - YEAR 3
```

```
INFLOWS

EXPORTS          $ 18 471
EXPENDITURES     $  2 125
INCOME           $    851

NET INFLOW     $ 21447


OUTFLOWS


IMPORTS          $ 18 335
EXPENDITURES     $  1 564
FOREIGN AID      $  4 353
INVESTMENTS      $  1 735

NET OUTFLOW     $ 25987


$ DIFFERENCE   -4540

% DIFFERENCE   -.22


ENTER YOUR POLICY DECISIONS FOR YEAR  4

WHAT PERCENT CHANGE DO YOU WISH
IN TAXES ON INVESTMENTS ABROAD?6
IN THE TARIFF RATE?2
IN GOVERNMENT SPENDING ABROAD?0
IN THE PRIME INTEREST RATE?.3


BALANCE STATEMENT - YEAR 4


INFLOWS

EXPORTS          $ 18 123
EXPENDITURES     $  2 108
INCOME           $    809

NET INFLOW     $ 21040
```

```
OUTFLOWS

IMPORTS          $ 17 074
EXPENDITURES     $  1 537
FOREIGN AID      $  4 353
INVESTMENTS      $  1 192

NET OUTFLOW      $ 24156


$ DIFFERENCE     -3116

% DIFFERENCE     -.15


UNFORTUNATELY YOU HAVE NOT RESTORED THE COUNTRY TO
A HEALTHY BALANCE OF PAYMENTS POSITION IN THE TIME
ALLOWED.  YOU SHOULD RETHINK YOUR STRATEGY BASED ON
THIS EXPERIENCE AND TRY THE GAME AGAIN.


DO YOU WANT TO TRY THE GAME AGAIN NOW?NO

DONE
```

COMPUTER-WRITTEN POETRY

I. IDENTIFICATION

Subject Area: Social Studies

Specific Topic: The Social Impact of the Computer: The Thinking Machine (Computer-Written Poetry)

Grade Level: Twelfth

Program Type: Prepared

Program Name: BARD

II. DESCRIPTION OF UNIT

Computer Program Materials

The BARD program is a man-machine poetry writing system. It represents an elementary example of how man and computer can join forces in the creative process. The user has the option of either turning complete control of the composition of the poem over to the machine or of controlling key aspects of the poem's structure himself. The user can choose to control:

1. The words in the machine's dictionary.
2. The number of lines in each stanza.
3. The number of syllables.
4. The rhyme scheme.

Once the structure of the poem has been determined, the computer will compose a poem from its dictionary within the prescribed structure.

Rationale for Computer Use

It is becoming increasingly clear that computers will soon be programmed to perform tasks that man has heretofore felt were in his own unique domain – in fact, tasks that previously have seemed to distinguish man from both beast and machine.

Already computers have been programmed to control complex industrial processes; to prove certain types of mathematical theorems; to play checkers and chess; to seem to be capable of engaging in simple conversations with man; and to learn from experience. The question "Can a computer think?" is very much open to serious debate today. Furthermore, computers are also being programmed to extend man's intellectual capabilities – to work with man interactively to do something that neither man nor machine could do alone. These man-machine systems are already helping man to explore the moon, to carry out intricate medical diagnoses and to compose and produce exciting new art forms.

The impact of the computer as a thinking machine on man's sense of identity and purpose promises to be extensive. For example, IBM researcher A.L. Samuel has programmed a computer to learn to play checkers. Several years ago Samuel arranged for his machine to play the New York State checker champion, a man in his late sixties, who had spent most of his life learning to play championship checkers. This man watched as, in a few minutes, the computer learned to play checkers by having a series of book games read into the computer's memory. The checker champion finally beat the machine, but it was a close game. After the match Samuel claimed that "If the machine could take an hour between moves it would beat you every time."

This example demonstrates clearly what a critical problem education has to solve – how to prepare today's youth to be able to maintain their dignity and identity in a technological society in which machines increasingly will be assuming roles that man has always felt were his own. Sometimes these roles may be ones a man spent years learning to do well.

The BARD program is an attempt to provide a concrete and understandable framework within which students can begin to wrestle with some of these basic problems, to provide them with a situation where they can become actively involved in working with a computer program whose output, at times at least, gives the appearance of thought.

III. INSTRUCTIONAL OBJECTIVES

Having completed this unit and worked with the BARD program, the student will be able to:

1. List at least five examples of tasks that the computer is already being programmed to do that only man could have done prior to the computer.
2. List at least five examples of man and computer working together today to perform either some task that man was previously unable to do alone or some task where the computer enables man to improve his previous performance.
3. List at least five examples of tasks which recognized experts feel, in the future, man will be able to program the computer to do.
4. Write an exhaustive set of instructions for a robot to play a simple game or to perform a task that would require thinking if a man were to do it.
5. Define at least three criteria which distinguish a task which the computer can be programmed to do from one which it is impossible for the computer to do.
6. Take an exemplary poem which a computer has composed and, using the poem as a basis of discussion, write a well-reasoned one- or two-page essay (or communicate in some other appropriate way) in which the student discusses the following:
   a. Whether the poem is meaningful to him.
   b. How his answer to the above would have been different if he had thought a man had composed the poem.
   c. Whether it makes any difference to him how the computer went about composing the poem; for example, the computer could have been programmed to:

(1) Select words at random from a list.

(2) Follow certain specified rules for selecting the words – rules that assure that the poem will conform to accepted word usage.

(3) Type out a poem that a man had written and stored in the machine.

7. Articulate his own feelings about living in a technological society in which computers will be able to do increasingly more of the thinking tasks that man is doing today.

IV. LEARNING SEQUENCE

Prerequisites

The student should know the meaning of the following terms used in the BARD program:

1. Stanza.
2. Rhyme scheme.

Activities

1. Review with the students the procedure for using a stored computer program.
2. Have the students run the BARD program several times, both keeping some control over the structure of the poems themselves and turning complete control over to the machine.
3. Encourage the students to discuss among themselves whether any of the poems communicate anything meaningful and whether their controlling certain aspects of the poem's structure seemed to have anything to do with the meaning.
4. Have the students carry out a project which surveys the opinions of other students and teachers who are not aware that a particular poem was composed by the computer. For example, have the student newspaper print several of the best BARD poems with a fictitious au-

thor. Ask students and teachers to discuss in class in their own words what they think of the poems.

5. Discuss with the students the differences between their impressions of the poems which they knew had been composed by the computer and the opinions of people who did not know a computer had composed them.

6. Discuss with the students the issue of computers being programmed to perform thinking tasks. This discussion could well be based on class readings, films or field trips (see Bibliography). In particular, discuss:

   a. Tasks the computer has already been programmed to do that only man could have done prior to the computer.

   b. Examples of man-machine systems where man and computer are working together to perform either some task that man was unable to do alone or tasks in which the computer enables man to improve his previous performance.

   c. Examples of tasks which recognized experts feel man, in the future, will be able to program the computer to do.

   d. The effect the computer performing thinking tasks will have on man; for example, Samuel's checker-playing machine described in the rationale of the unit might serve as a basis for this discussion. (The film *The Thinking Machine* noted in the Bibliography is particularly good here.)

7. Have the students work in small groups and present some problems which they have to instruct a robot to solve such as:

   a. To travel through a particular maze set up in the room.

   b. To play the game of hide and seek.

   c. To cross the street,

The task of each group is to write an exhaustive and unambiguous set of instructions for a robot to follow. Have a student not involved in writing the instructions play the part of the robot to test them.

Note: Be sure to impress upon the robot to do exactly what, and only what, the instructions say to do. Also tell him to balk if an instruction is ambiguous or requires him to think.

8. Discuss with the students the differences between problems for which it would be possible to write detailed instructions for a robot to solve and problems for which it is impossible to write such instructions.

DEMONSTRATION RUN – BARD

```
RUN

DO YOU WISH TO SEE A DESCRIPTION OF THE 'BARD' PROGRAM? YES


THE 'BARD' PROGRAM IS A MAN-MACHINE POETRY WRITING SYSTEM.
THE USER HAS THE OPTION OF EITHER TURNING COMPLETE CONTROL
OF THE COMPOSITION OVER TO THE MACHINE OR OF CONTROLLING
KEY ASPECTS OF THE POEM'S STRUCTURE HIMSELF. THE 'BARD'
PROGRAM PROVIDES A FRAMEWORK WITHIN WHICH THE USER CAN
BECOME ACTIVELY INVOLVED IN STUDYING JUST HOW IMPORTANT IS
THE POEM'S STRUCTURE IN DETERMINING ITS MEANING. ALSO THE
'BARD' PROGRAM REPRESENTS AN ELEMENTARY EXAMPLE OF HOW MAN
AND COMPUTER, IN THE FUTURE, WILL JOIN TOGETHER MORE IN THE
CREATIVE PROCESS.
HOPEFULLY, BY USING THIS PROGRAM AND DISCUSSING IT WITH
OTHERS, YOU WILL BEGIN TO THINK MORE SERIOUSLY ABOUT HOW
MAN AND THE COMPUTER CAN WORK TOGETHER, AND WHAT IT MEANS
WHEN PEOPLE TRY TO CLAIM THAT COMPUTERS CAN DO THINGS LIKE
COMPOSE POETRY.


DO YOU WISH TO ENTER YOUR OWN DICTIONARY? YES


YOU WILL BE ENTERING THE DICTIONARY BY LISTS. ALL BUT THE
LAST LIST WILL BE OF RHYMING WORDS. THE LAST LIST WILL
CONSIST OF ARTICLES, CONJUNCTIONS, ETC. THAT YOU HAVE NOT
INCLUDED IN YOUR RHYME LISTS.

HOW MANY LISTS OF WORDS DO YOU WISH TO ENTER? 3

WHAT IS THE LARGEST NUMBER OF SYLLABLES IN WORD LIST 1 ? 3
HOW MANY WORDS HAVE 1 SYLLABLES? 3
ENTER THESE WORDS AFTER THE ? ,ONE WORD PER LINE.
? FUN
? SUN
? TOW
```

```
HOW MANY WORDS HAVE 2 SYLLABLES? 4
ENTER THESE WORDS AFTER THE ? ,ONE WORD PER LINE.
? NATION
? RATION
? STATION
? CAUTION
HOW MANY WORDS HAVE 3 SYLLABLES? 2
ENTER THESE WORDS AFTER THE ? ,ONE WORD PER LINE.
? CESSATION
? CITATION

WHAT IS THE LARGEST NUMBER OF SYLLABLES IN WORD LIST 2 ? 2
HOW MANY WORDS HAVE 1 SYLLABLES? 4
ENTER THESE WORDS AFTER THE ? ,ONE WORD PER LINE.
? BOUND
? FOUND
? SOUND
? MOUND
HOW MANY WORDS HAVE 2 SYLLABLES? 3
ENTER THESE WORDS AFTER THE ? ,ONE WORD PER LINE.
? OUTBOUND
? EXPOUND
? AGROUND

WHAT IS THE LARGEST NUMBER OF SYLLABLES IN WORD LIST 3 ? 2
HOW MANY WORDS HAVE 1 SYLLABLES? 8
ENTER THESE WORDS AFTER THE ? ,ONE WORD PER LINE.
? AND
? BUT
? NOR
? ON
? TO
? GO
? STAND
? LEAVE
HOW MANY WORDS HAVE 2 SYLLABLES? 6
ENTER THESE WORDS AFTER THE ? ,ONE WORD PER LINE.
? UPON
? AGAINST
? RELIEVE
? QUICKEN
? ALTER
? REALLY
```

```
WHICH OF THE FOLLOWING DO YOU CHOOSE:
  1  TO KEEP SOME CONTROL OF THE POEM'S STRUCTURE YOURSELF
  2  TO GIVE THE MACHINE COMPLETE CONTROL
? 1


FOR THE QUESTIONS WHICH FOLLOW THAT REQUIRE YOU TO ANSWER
WITH A NUMBER, IF YOU WISH TO MAKE THE COMPUTER MAKE THE
DETERMINATION, ENTER 0 (ZERO).


HOW MANY STANZAS DO YOU WISH TO HAVE IN THE POEM? 2

DO YOU WISH TO HAVE SOME CONTROL OVER THE NUMBER OF LINES
IN THE POEM? YES

DO YOU WANT THE SAME NUMBER OF LINES IN EACH STANZA? YES

HOW MANY LINES DO YOU WISH IN EACH STANZA? 4


DO YOU WISH TO HAVE SOME CONTROL OVER THE SYLLABLE
STRUCTURE OF THE POEM? YES


DO YOU WISH THE NUMBER OF SYLLABLES IN EACH LINE TO BE
CONSTANT? NO


PLEASE ENTER THE NUMBER OF SYLLABLES YOU WANT IN
STANZA 1
   LINE 1 ? 8
   LINE 2 ? 0
THE NUMBER OF SYLLABLES IN THIS LINE WILL BE 15
   LINE 3 ? 12
   LINE 4 ? 8

STANZA 2
   LINE 1 ? 6
   LINE 2 ? 0
THE NUMBER OF SYLLABLES IN THIS LINE WILL BE 10
   LINE 3 ? 7
   LINE 4 ? 10
```

DO YOU WISH TO HAVE SOME CONTROL OVER THE RHYME SCHEME? YES

DO YOU WANT TO SEE THE INSTRUCTIONS FOR RHYME PATTERN? YES

YOU WILL ENTER THE DESIRED RHYME SCHEME BY ENTERING A SEQUENCE OF NUMBERS. EQUAL NUMBERS INDICATE YOUR DESIRE TO HAVE THE LAST WORDS IN THE RESPECTIVE LINES RHYME. UNEQUAL NUMBERS WILL MEAN THAT THE WORDS WILL NOT RHYME. FOR EXAMPLE, SUPPOSE THAT YOU ARE WORKING WITH A FOUR LINE POEM AND YOU WISH THE FIRST AND THIRD LINES TO RHYME RESPECTIVELY. YOU MIGHT THEN ENTER THE FOLLOWING SEQUENCE OF NUMBERS: 9,5,9,5.

WHEN ENTERING DATA IN THIS PROGRAM, SEPARATE ENTRIES BY A CARRIAGE RETURN, NOT A COMMA, AND WAIT FOR THE COMPUTER TO RESPOND WITH A '?' BEFORE TYPING THE NEXT NUMBER.

YOU MAY ENTER A MAXIMUM OF 2 DIFFERENT NUMBERS FOR THE RHYME SCHEME.

DO YOU WANT THE RHYME PATTERN TO BE THE SAME FOR EACH STANZA? YES

WHAT IS THE RHYME SCHEME
? 1
? 2
? 1
? 1

```
          A POEM

REALLY AGAINST EXPOUND BOUND TO
STATION BOUND TON BOUND AGROUND CITATION SOUND MOUND CESSATION
NOR ON RELIEVE BOUND NATION CESSATION ALTER
SOUND REALLY BOUND NOR STAND AGAINST

STAND ALTER FUN STAND GO
LEAVE CITATION SOUND AGROUND BUT STATION
FUN CESSATION NOR AGAINST
CESSATION EXPOUND STAND AGAINST


DO YOU WANT ANOTHER POEM USING THE SAME DICTIONARY? NO

DO YOU WANT TO ENTER A DIFFERENT DICTIONARY? NO

READY

RUN

DO YOU WISH TO SEE A DESCRIPTION OF THE 'BARD' PROGRAM? NO


DO YOU WISH TO ENTER YOUR OWN DICTIONARY? NO
DO YOU WISH TO SEE A LIST OF THE MACHINE DICTIONARY? NO


WHICH OF THE FOLLOWING DO YOU CHOOSE:
  1  TO KEEP SOME CONTROL OF THE POEM'S STRUCTURE YOURSELF
  2  TO GIVE THE MACHINE COMPLETE CONTROL
? 2


DO YOU WISH TO HAVE SOME CONTROL OVER THE RHYME SCHEME? NO
```

```
          A POEM

SLUM AID
PLUM DUB
AYE SUM

DYE SUCK
DYE MAID

RESOUND
COLONIZE



DO YOU WANT ANOTHER POEM USING THE SAME DICTIONARY? YES

DO YOU WANT TO USE THE SAME STRUCTURE? YES

DO YOU WANT TO USE THE SAME RHYME SCHEME? YES



          A POEM

PAIN DRAIN
CAMPAIGN
PIES FOUNT

DYE DYE
DYE DYE

ROUND CLOUD
DYE SUCH



DO YOU WANT ANOTHER POEM USING THE SAME DICTIONARY? NO

DO YOU WANT TO ENTER A DIFFERENT DICTIONARY? NO
```

```
RUN

DO YOU WISH TO SEE A DESCRIPTION OF THE 'BARD' PROGRAM? NO


DO YOU WISH TO ENTER YOUR OWN DICTIONARY? NO
DO YOU WISH TO SEE A LIST OF THE MACHINE DICTIONARY? NO


WHICH OF THE FOLLOWING DO YOU CHOOSE:
  1  TO KEEP SOME CONTROL OF THE POEM'S STRUCTURE YOURSELF
  2  TO GIVE THE MACHINE COMPLETE CONTROL
? 1


FOR THE QUESTIONS WHICH FOLLOW THAT REQUIRE YOU TO ANSWER
WITH A NUMBER, IF YOU WISH TO MAKE THE COMPUTER MAKE THE
DETERMINATION, ENTER 0 (ZERO).


HOW MANY STANZAS DO YOU WISH TO HAVE IN THE POEM? 1

HOW MANY LINES DO YOU WISH TO  HAVE IN THE POEM? 6


DO YOU WISH TO HAVE SOME CONTROL OVER THE SYLLABLE
STRUCTURE OF THE POEM? YES

DO YOU WISH THE NUMBER OF SYLLABLES IN EACH LINE TO BE
CONSTANT? NO
```

```
PLEASE ENTER THE NUMBER OF SYLLABLES YOU WANT IN
STANZA 1
   LINE 1 ? 8
   LINE 2 ? 6
   LINE 3 ? 8
   LINE 4 ? 6
   LINE 5 ? 8
   LINE 6 ? 6

DO YOU WISH TO HAVE SOME CONTROL OVER THE RHYME SCHEME? YES

DO YOU WANT TO SEE THE INSTRUCTIONS FOR RHYME PATTERN? NO

YOU MAY ENTER A MAXIMUM OF  10 DIFFERENT NUMBERS FOR
THE RHYME SCHEME.

WHAT IS THE RHYME SCHEME
? 1
? 2
? 3
? 1
? 2
? 3

          A POEM

LOUD DISENDOWED SWINE OUTBOUND ROUND
THENCE WHENCE AIRLINE ALOUD
CROWD SHUN SHUN NATION SHROUD SUN TINE
PRETENSE VINE MERRY-GO-ROUND
DISENDOWED CONFERENCE ALOUD
HENCE PROUD SHUN PORCUPINE
```

```
DO YOU WANT ANOTHER POEM USING THE SAME DICTIONARY? NO

DO YOU WANT TO ENTER A DIFFERENT DICTIONARY? NO

READY

RUN

DO YOU WISH TO SEE A DESCRIPTION OF THE 'BARD' PROGRAM? NO


DO YOU WISH TO ENTER YOUR OWN DICTIONARY? NO
DO YOU WISH TO SEE A LIST OF THE MACHINE DICTIONARY? NO


WHICH OF THE FOLLOWING DO YOU CHOOSE:
  1  TO KEEP SOME CONTROL OF THE POEM'S STRUCTURE YOURSELF
  2  TO GIVE THE MACHINE COMPLETE CONTROL
? 2


DO YOU WISH TO HAVE SOME CONTROL OVER THE RHYME SCHEME? NO
```

A POEM

COLLATION
OVERCROWD INCLINE COLLECT LEAVE ENSHROUD
AGROUND UNBOWED HUMANIZATION FOUND FINE UNDERGROUND ABOUND
OTHER FENCE ENSHROUD ALIGN CAUTION SCENT UNDERGROUND BUT

INCENSE SHROUD FINE BESIDE ACUTION SPENT CARBINE ASTONISHMENT SON THE
SPELLBOUND COMMENT STAND
FOUND OBEDIENCE DALMATION SHROUD COMMENSE UNDERGROUND
SPELLBOUND ELOQUENT SOUND EMINENT

OBEDIENCE MERRY-GO-ROUND CREATION REVERENT
UNBOWED EMBARASSMENT DALMATION ENTER CROWN TRUNCATE
ENSHROUD GUN WINE STEIN CONFOUND SPINE THENCE GROUND ARGENTINE COLLATION
ARGUMENT INBOUND
ARGUMENT SON INSTRUMENT

ROUND INNOCENCE
BRINE CONFLUENT CARNATION DIFFERENCE ICEBOUND
SOUND ACCUSATION DIFFERENCE GROUND PROUD
EXHUME CROWD CIRCUMFERENCE COASTLINE ACTIVATION UNLEASH DEFENSE PENITENT

SIGN DISENDOWED REPENT
LINE STEIN HOUND AGROUND BRINE REALLY REPEAT BYZANTINE SUN SON FOUND
TENT FOUND ENSHROUD STATION ARGMUENT SPINE FUN COLLECT ALTER THENCE
ASTONISHMENT
EMBARASSMENT DISENDOWED

INTERPERSONAL RELATIONSHIPS

I. IDENTIFICATION

Subject Area: Modern Problems, Family Life, Social Studies

Specific Topic: Interpersonal Relationships

Grade Level: Seventh to Twelfth

Program Type: Prepared

Program Name: GAME

II. DESCRIPTION OF UNIT

Computer Program Materials

This program is a relatively simple interaction game. The objective of the game is for a student to choose the strategies which will persuade a parent to agree with him. The computer serves as an intermediary between the parent and student while an issue is discussed. The computer poses the issue. In this game the issue is whether or not the student can go on a date Saturday night. The program then gives the student a list of six responses from which he can choose. The responses are:

1. O.K., I will stay home.
2. But I'd really like to go. All my friends are going.
3. If all my work is done, I should be able to go.
4. If you let me go out, I'll babysit all next week.
5. You never let me do what I want to do.
6. I'm going anyway.

Based on the student's response, the computer tells the student what his parent said. This continues until the student has selected a maximum of three responses or until agreement is reached.

The student now has the choice of either honoring the agreement (if one has been made) or not honoring it. The parent then either checks up on the student or does not to see if he

sticks to his agreement. As all of this proceeds, the student is either gaining or losing points.

In this game only the student can change his strategy and the person at the input device is always cast in the student's role. It would be possible to change the program to allow the following:

1. The parent could be given different strategies.
2. The person at the input device could choose to be either the parent or the child.
3. Other issues could be discussed.

Rationale for Computer Use

In this age of the generation gap, the computer can serve as a neutral third party. Students can try out different strategies on the hypothetical parent without having to suffer the consequences. The computer in its neutral role offers no threat to the student. It will not try to influence his decisions.

III. INSTRUCTIONAL OBJECTIVES

After playing the game through three times, the student should:

1. Be able to choose the response pattern that gives him the most points.
2. Be able to identify the response or responses that give him the most points.
3. Make decisions based on a compromising strategy.

When the game is finished, the computer will ask if the student thinks he can do better by playing again and approaching the discussion in a different manner. This question can aid in evaluating whether or not the game is accomplishing what is intended.

IV. LEARNING SEQUENCE

Prerequisites

There are no prerequisites to this unit.

Activities

This game is meant to be played by one student seated at an input/output device. The game should be played a minimum of three times. It could also be used in a demonstration situation with a whole class. A television camera and monitor would be needed to show what is being output. Used in such a manner, the program could be the focal point for a group discussion concerning parent-student relationships in resolving problems.

Note: The GAME program contained in this unit is an elementary prototype. It is included as a rather simple, limited example of the kind of game which could be developed.

NOTES

DEMONSTRATION RUN – GAME

```
GAME

DO YOU WANT DIRECTIONS?
?YES
YOU ARE GOING TO PLAY A GAME IN WHICH YOU WILL DISCUSS
A PROBLEM WITH YOUR FATHER AND ATTEMPT TO GET HIM
TO AGREE WITH YOU IN THREE TRIES.

FOR EACH STATEMENT YOU MAKE, I WILL TELL YOU
WHAT YOUR FATHER REPLIED.

YOU MUST ALWAYS SELECT YOUR STATEMENTS FROM ONE
OF THE FOLLOWING SIX.

**********************************************************
1.  O.K. I WILL STAY HOME.
2.  BUT I'D REALLY LIKE TO GO. ALL MY FRIENDS ARE GOING.
3.  IF ALL MY WORK IS DONE, I SHOULD BE ABLE TO GO.
4.  IF YOU LET ME GO OUT I'LL BABYSIT ALL NEXT WEEK.
5.  YOU NEVER LET ME DO WHAT I WANT TO DO.
6.  I'AM GOING ANYWAY!
**********************************************************

WHEN A QUESTION MARK APPEARS, TYPE THE NUMBER
OF YOUR RESPONSE FOLLOWED BY RETURN.

YOU WILL RECEIVE POINTS BASED ON HOW SUCCESSFULL YOU
ARE AT CONVINCING YOUR FATHER.

THE FIRST ISSUE IS:

     YOU WANT TO GO OUT SATURDAY NIGHT.
     YOUR FATHER OPPOSES THE IDEA.

WHEN YOU FIRST BRING UP THE IDEA, YOUR FATHER STATES:

NO, YOU CAN NOT GO OUT ON A DATE SAT. NITE AND THATS THAT.
HOW WOULD YOU APPROACH YOUR FATHER?
WHAT WOULD YOU SAY FIRST?
?3
```

```
YOUR FATHER SAID.
WELL, MAYBE, BUT I DON'T THINK YOU SHOULD GO.
WHAT IS YOUR REPLY?
?2
YOUR FATHER SAID:
I DON'T THINK YOU DESERVE TO GO OUT SAT. NITE.
WHAT IS YOUR REPLY?
?4
YOUR FATHER SAID:
O.K. IF YOU DO THAT YOU CAN GO OUT SAT. NITE.

ON A SCALE OF -7 TO 4, YOUR SCORE WAS 4     POINTS.
IT IS NOW SAT. NITE, WHICH DO YOU DO?
     1. GO OUT.
     2. STAY HOME.
?2
YOUR FATHER DIDN'T CHECK UP ON YOU.
YOUR SCORE IS NOW  4     POINTS.
WELL DONE!

DO YOU THINK YOU COULD DO BETTER IF YOU HAD ANOTHER
CHANCE AND APPROACHED YOUR FATHER A DIFFERENT WAY?
?2
WOULD YOU LIKE TO TRY AGAIN?
?1
WHICH STATEMENT DO YOU FEEL WAS MOST EFFECTIVE IN
CONVINCING YOUR FATHER
?4

DONE
```

MEAN, VARIANCE, STANDARD DEVIATION, STANDARD ERROR OF THE MEAN, AND T-TEST

I. IDENTIFICATION

Subject Area: Social Studies

Specific Topic: Mean, Variance, Standard Deviation, Standard Error of the Mean, and T-Test

Grade Level: Twelfth

Program Type: Student-Written or Prepared

Prepared Program Name: STATIS

II. DESCRIPTION OF UNIT

Computer Program Materials

This unit contains a computer program which could be written by a student or could be used as a packaged program. The program will calculate the mean, variance, standard deviation, standard error of the mean, and T-test value for any number of pieces of data in two samples. The following formulas were used:

$$\text{Mean} = \frac{\sum_{I=1}^{N} X_I}{N}$$

$$\text{Variance} = \frac{\sum_{I=1}^{N} (X_I - \text{mean})^2}{N - 1}$$

$$\text{Standard deviation} = \sqrt{\text{variance}}$$

$$\text{Standard error of the mean} = \frac{\text{standard deviation}}{\sqrt{N}}$$

where N is the total number of pieces of data

Also, the following formula for the T-test value of two samples was used. (This formula assumes homogeneity of vari-

ance – that is, that the samples being compared are drawn from the same general population so that the same order of magnitude of variance among subjects in the two samples may be expected.) In the formula:

$\overline{X}_1$ = mean of Sample 1

$\overline{X}_2$ = mean of Sample 2

N_1 = the number in Sample 1

N_2 = the number in Sample 2

S_1^2 = the variance of Sample 1

S_2^2 = the variance of Sample 2

$$T = \frac{\overline{X}_1 - \overline{X}_2}{\sqrt{\frac{(N_1 - 1)S_1^2 + (N_2 - 1)S_2^2}{N_1 + N_2 - 2}\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}}$$

If fundamental differences exist between the two populations being sampled, consult any standard reference in statistics for the T-test formula which takes into account the difference in variance between the two samples. (If there is any doubt, the reference also will describe the use of the F-test to determine the probability of homogeneity of variance.)

Rationale for Computer Use

Use of the program in a prepared form would save class time for an instructor who simply wanted to reduce the data of an experiment. A student could write the program, in which case,a major objective would be to better understand the following two concepts:

1. Use of summation notation.
2. How to calculate the above-mentioned quantities.

Most calculations using the above formula involve decimal numbers and are extremely tedious. Seldom can a student carry out these calculations without making arithmetic errors. Using this program as a problem-solving tool relieves the student of this large computational burden. Use of the computer

also removes any restrictions on the numbers which can be used in problems.

III. INSTRUCTIONAL OBJECTIVES

After completing an experiment which involves two samples (control and experimental), the student could use the prepared program to calculate the aforementioned quantities. If the student wishes to write the program himself, the following instructional objectives would be appropriate:

1. Given the number of pieces of data in a sample and their values, the student will:
   a. Calculate the mean.
   b. Calculate the variance.
   c. Calculate the standard deviation.
   d. Calculate the standard error of the mean.
2. Given the above statistics, a through d, for the experiment and control samples, the student will calculate a T-test value.

IV. LEARNING SEQUENCE

Prerequisites

1. The student should have calculated the five above-mentioned quantities by hand to realize what is involved and to become familiar with the formulas.
2. The concepts of variance, standard deviation, and standard error of the mean and the significance of the T-test value should be covered after the student has hand calculated the quantities but before he attempts to write a program.
3. If the program is to be used as a prepared one, the student should be given these instructions for running it. The program is not self-explanatory. Statements 5000 – 9990 have been reserved for data entries. Data for the two samples should be entered in the following way:

a. After calling up the program STATIS, type the line number 5000, followed by the word DATA, followed by:

   (1) The number of data values to be entered for the first sample.

   (2) The actual data values for the first samples.

b. If more than one line is needed, type the next consecutive line number, and the word DATA, followed by additional data values; on the next line, the next number, the word DATA, then more data values; on the next line, the next number and so on until all the data have been entered.

   Note: Place no punctuation at the end of a line of data. The computer will then accept a continuation of data on the next line.

c. For the sake of clarity in the data table (or for larger numbers of data values) the second sample may begin with a new line as in the example following. Remember that as each new line is needed, it must begin with the next consecutive line number and the word DATA, followed by the remaining values.

d. The program will accommodate up to 50 values in each sample. When all data values have been entered, the carriage should be returned, and the word RUN typed. When the carriage is returned again, analysis of the data begins.

Example: In this case, each sample contains 16 values, the second sample beginning on a new line.

```
GET-STATIS
5000        DATA   16,    61,64,51,58,52,63,56,52,63,64,60,62
5010        DATA          61,53,56,44
5020        DATA   16,    72,48,48,71,43,68,44,39,76,55,67,65
5030        DATA          83,43,26,49
RUN
```

Activities

1. The teacher should put a flowchart on the board for calculating the mean of a list of data values. The student should be asked to expand the flowchart so that it illustrates the calculation of the other quantities.
2. Once the flowchart has been successfully drawn, a program should be written from it.
3. The above mentioned flowchart could be amended to include calculation of the T-test value.
4. Once a program is written to calculate the four desired quantities, the same program can be used with two different sets of data, thereby setting up the values to be used in the T-test formula.

NOTES

DEMONSTRATION RUN – STATIS

```
RUN
STATIS


SAMPLE 1 VALUES ARE

MEAN = 43.8571
VARIANCE = 697.81
STANDARD DEVIATION = 26.4161
STANDARD ERROR OF THE MEAN = 9.98434


SAMPLE 2 VALUES ARE

MEAN = 645
VARIANCE = 84828.
STANDARD DEVIATION = 291.252
STANDARD ERROR OF THE MEAN = 130.252

T TEST VALUE =-5.53934

SAMPLE 1 VALUES ARE

MEAN = 4.55556
VARIANCE = 7.77778
STANDARD DEVIATION = 2.78887
STANDARD ERROR OF THE MEAN = .929622


SAMPLE 2 VALUES ARE

MEAN = 16
VARIANCE = 6.66667
STANDARD DEVIATION = 2.58199
STANDARD ERROR OF THE MEAN = 1.29099

T TEST VALUE =-6.96588


DONE
```

NOTES

BEST LINE FIT FOR A SET OF POINTS

I. IDENTIFICATION

Subject Area: Social Studies

Specific Topic: Best Line Fit for a Set of Points

Grade Level: Tenth, Eleventh, Twelfth

Program Type: Student-Written or Prepared

Prepared Program Name: BESFIT

II. DESCRIPTION OF UNIT

Computer Program Materials

This unit contains a computer program that could be written by a student or could be used as a packaged program. This program will calculate the slope and Y-intercept values for a linear equation. This linear equation, in slope-intercept form, represents the equation for the line that best fits a given set of data points.

In solving this problem the following two equations must be solved simultaneously.

$$NB + (\Sigma X)M = \Sigma Y$$

$$(\Sigma X)B + (\Sigma X^2)M = \Sigma XY$$

where:

N is the total number of experimentally-obtained data points.

ΣX is the summation of all N of the independent variable values.

ΣY is the summation of all N of the dependent variable values.

ΣX^2 is the summation of all N independent variable values squared.

ΣXY is the summation of all N independent variable values times dependent variable values.

B is the Y-intercept.

M is the slope.

Rationale for Computer Use

The amount of hand calculation in doing the above problem is tremendous. Decimal numbers are usually involved, which increases the probability of errors. This problem would take hours even if an ordinary desk calculator were used. The computer can handle the decimal numbers without error. By being able to draw the graph of the best line, students can more easily see relationships between the variables involved.

III. INSTRUCTIONAL OBJECTIVES

The program, used in its prepared form, is simply a computational tool. If the student writes the program, however, the following instructional objectives would be appropriate:

Given the experimentally-obtained data points, the student should be able to:

1. Find ΣX, ΣY, ΣXY, ΣX^2 and N.
2. Solve two linear equations in two unknowns

To do this, the student must write two programs in one. The first part of his program must calculate those quantities in 1 above. Solving the resulting two linear equations is the second part. Either program alone is an excellent programming exercise. If they are written separately, the exercise of tying the two programs together is excellent programming practice.

IV. LEARNING SEQUENCE

Prerequisites

1. The student must understand subscript notation and its use.
2. He must understand summation notation and its use.
3. He must be able to solve two linear equations in two unknowns.

4. If the program is to be used as a prepared one, the student need only have ready in advance the number of pairs of data values to be entered and the data values themselves. These numbers will be entered according to directions given by the computer.

Activities

1. Introductory remarks:

   Most students can eyeball a straight line to a set of data points which are graphed to form a scatter diagram. This is usually the method used in a class. The student should be made aware of the fact that there is a best line that can be found by simple algebraic means.

   The amount of variation between the experimentally obtained points and the points on the best line is the minimum amount of variation possible. In order to minimize this variation, the principle of least squares is employed. This results in the two aforementioned linear equations. By solving these two equations for B and M, the student can obtain the Y-intercept and slope for the equation of the best line for a given number N of data points.

2. The teacher should point out to students that the computer automatically gives computed results to six digits. This is obviously far beyond the number of significant figures usually obtained in laboratory measurements. The teacher might use this as a springboard leading to a discussion of the problem of establishing the significance of figures with respect to measured quantities as opposed to the number of figures produced by calculations (particularly when square roots or operations involving other irrational numbers are involved).

3. The student in writing the program should take into consideration the possibility that the lines might be parallel and non-intersecting, and the possibility that the two equations will produce the same line. Both cases

produce division by zero. The program should contain statements to test for this. The program should also distinguish between the two cases.

DEMONSTRATION RUN – BESFIT

```
RUN
BESFIT

HOW MANY PAIRS OF VALUES DO YOU HAVE?
?5
AFTER EACH QUESTION MARK ENTER ONE PAIR OF VALUES.
?12,24
?334.9,2.337
?45,75.95
?63,11,29
?378,945

BEST LINE EQUATION IS  Y =  1.50488    X + -35.4593


WOULD YOU LIKE TO ENTER NEW VALUES?
?YES
HOW MANY PAIRS OF VALUES DO YOU HAVE?
?2
AFTER EACH QUESTION MARK ENTER ONE PAIR OF VALUES.
?89.5,97.453
?.345,1.749

BEST LINE EQUATION IS  Y =  1.07346    X +  1.37867


WOULD YOU LIKE TO ENTER NEW VALUES?
?NO

DONE
```

NOTES

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